CHAPTER 7

Interest Rates and Bond Valuation

What do Canadian Imperial Bank of Commerce, Domtar, Loblaw, Husky Energy, and Rogers Communications all have in common? Like many other corporations they have all borrowed money from investors by issuing bonds. Some of these companies have higher debt loads and lower bond ratings than others. Bonds issued by such riskier companies carry higher yields. In this chapter, we will learn more about bonds and what makes them risky or safe.

OUR GOAL in this chapter is to introduce you to bonds. We begin by showing how the techniques we developed in Chapters 5 and 6 can be applied to bond valuation. From there, we go on to discuss bond features and how bonds are bought and sold. One important thing we learn is that bond values depend, in large part, on interest rates. We therefore close out the chapter with an examination of interest rates and their behaviour.

7.1 BONDS AND BOND VALUATION

www.cibc.com
www.domtar.com
www.loblaw.com
www.huskyenergy.ca
www.rogers.com

When a corporation or government wishes to borrow money from the public on a long-term basis, it usually does so by issuing or selling debt securities that are generically called bonds. In this section, we describe the various features of corporate bonds and some of the terminology associated with bonds. We then discuss the cash flows associated with a bond and how bonds can be valued using our discounted cash flow procedure.

Bond Features and Prices

A bond is normally an interest-only loan, meaning the borrower pays the interest every period, but none of the principal is repaid until the end of the loan. For example, suppose Alcan wants to borrow $1,000 for 30 years and that the interest rate on similar debt issued by similar corporations is 12 percent. Alcan thus pays $.12 \times \$1,000 = \$120$ in interest every year for 30 years. At the end of 30 years, Alcan repays the $1,000. As this example suggests, a bond is a fairly simple financing arrangement. There is, however, a rich jargon associated with bonds, so we use this example to define some of the more important terms.

coupons
The stated interest payments made on a bond.

face value
The principal amount of a bond that is repaid at the end of the term. Also par value.

In our example, the $120 regular interest payments that Alcan promises to make are called the bond's **coupons.** Because the coupon is constant and paid every year, the type of bond we are describing is sometimes called a *level coupon bond.* The amount repaid at the end of the loan is called the bond's **face value** or **par value.** As in our example, this par value is usually $1,000 for corporate bonds, and a bond that sells for its par value is called a par bond. Government of Canada and provincial bonds frequently have much larger face or par values. Finally, the annu-

coupon rate
The annual coupon divided by the face value of a bond.

maturity date
Specified date at which the principal amount of a bond is paid.

al coupon divided by the face value is called the **coupon rate** on the bond, which is $120/1,000 = 12%; so the bond has a 12 percent coupon rate.

The number of years until the face value is paid is called the bond's time to **maturity.** A corporate bond would frequently have a maturity of 30 years when it is originally issued, but this varies. Once the bond has been issued, the number of years to maturity declines as time goes by.

Bond Values and Yields

As time passes, interest rates change in the marketplace. The cash flows from a bond, however, stay the same because the coupon rate and maturity date are specified when it is issued. As a result, the value of the bond fluctuates. When interest rates rise, the present value of the bond's remaining cash flows declines, and the bond is worth less. When interest rates fall, the bond is worth more.

To determine the value of a bond on a particular date, we need to know the number of periods remaining until maturity, the face value, the coupon, and the market interest rate for bonds with similar features. This interest rate required in the market on a bond is called the bond's **yield to maturity (YTM).** This rate is sometimes called the bond's *yield* for short. Given this information, we can calculate the present value of the cash flows as an estimate of the bond's current market value.

yield to maturity (YTM)
The market interest rate that equates a bond's present value of interest payments and principal repayment with its price.

For example, suppose Royal Bank were to issue a bond with 10 years to maturity. The Royal Bank bond has an annual coupon of $56. Suppose similar bonds have a yield to maturity of 5.6 percent. Based on our previous discussion, the Royal Bank bond pays $56 per year for the next 10 years in coupon interest. In 10 years, Royal Bank pays $1,000 to the owner of the bond. The cash flows from the bond are shown in Figure 7.1. What would this bond sell for?

www.royalbank.com

As illustrated in Figure 7.1, the Royal Bank bond's cash flows have an annuity component (the coupons) and a lump sum (the face value paid at maturity). We thus estimate the market value of the bond by calculating the present value of these two components separately and adding the results together. First, at the going rate of 5.6 percent, the present value of the $1,000 paid in 10 years is:

$$\text{Present value} = \$1{,}000/1.056^{10} = \$1{,}000/1.7244 = \$579.91$$

Second, the bond offers $56 per year for 10 years, so the present value of this annuity stream is:

$$\begin{aligned}\text{Annuity present value} &= \$56 \times (1 - 1/1.056^{10})/.056 \\ &= \$56 \times (1 - 1/1.7244)/.056 \\ &= \$56 \times 7.5016 \\ &= \$420.09\end{aligned}$$

A good bond site to visit is www.bonds.yahoo.com

We can now add the values for the two parts together to get the bond's value:

$$\text{Total bond value} = \$579.91 + 420.09 = \$1{,}000.00$$

Figure 7.1

Cash flows for Royal Bank

Year	0	1	2	3	4	5	6	7	8	9	10
Coupon		$56	$56	$56	$56	$56	$56	$56	$56	$56	$56
Face value		—	—	—	—	—	—	—	—	—	$1,000
		$56	$56	$56	$56	$56	$56	$56	$56	$56	$1,056

As shown, the Royal Bank bond has an annual coupon of $56 and a face or par value of $1,000 paid at maturity in 10 years.

This bond sells for its exact face value. This is not a coincidence. The going interest rate in the market is 5.6 percent. Considered as an interest-only loan, what interest rate does this bond have? With a $56 coupon, this bond pays exactly 5.6 percent interest only when it sells for $1,000.

To illustrate what happens as interest rates change, suppose a year has gone by. The Royal Bank bond now has nine years to maturity. If the interest rate in the market had risen to 7.6 percent, what would the bond be worth? To find out, we repeat the present value calculations with nine years instead of 10, and a 7.6 percent yield instead of a 5.6 percent yield. First, the present value of the $1,000 paid in nine years at 7.6 percent is:

On-line bond calculators are available at www.personal.fidelity.com

$$\text{Present value} = \$1{,}000/1.076^9 = \$1{,}000/1.9333 = \$517.25$$

Second, the bond now offers $56 per year for nine years, so the present value of this annuity stream at 7.6 percent is:

$$\begin{aligned}\text{Annuity present value} &= \$56 \times (1 - 1/1.076^9)/.076\\ &= \$56 \times (1 - 1/1.9333)/.076\\ &= \$56 \times 6.3520\\ &= \$355.71\end{aligned}$$

We can now add the values for the two parts together to get the bond's value:

$$\text{Total bond value} = \$517.25 + 355.71 = \$872.96$$

Therefore, the bond should sell for about $873. In the vernacular, we say this bond, with its 5.6 percent coupon, is priced to yield 7.6 percent at $873.

The Royal Bank bond now sells for less than its $1,000 face value. Why? The market interest rate is 7.6 percent. Considered as an interest-only loan of $1,000, this bond pays only 5.6 percent, its coupon rate. Because this bond pays less than the going rate, investors are only willing to lend something less than the $1,000 promised repayment. A bond that sells for less than face value is a *discount bond.*

The only way to get the interest rate up to 7.6 percent is for the price to be less than $1,000 so that the purchaser, in effect, has a built-in gain. For the Royal Bank bond, the price of $873 is $127 less than the face value, so an investor who purchased and kept the bond would get $56 per year and would have a $127 gain at maturity as well. This gain compensates the lender for the below-market coupon rate.

Another way to see why the bond is discounted by $127 is to note that the $56 coupon is $20 below the coupon on a newly issued par value bond, based on current market conditions. By this we mean the bond would be worth $1,000 only if it had a coupon of $76 per year. In a sense, an investor who buys and keeps the bond gives up $20 per year for nine years. At 7.6 percent, this annuity stream is worth:

$$\begin{aligned}\text{Annuity present value} &= \$20 \times (1 - 1/1.076^9)/.076\\ &= \$20 \times 6.3520\\ &= \$127.04\end{aligned}$$

This is just the amount of the discount.

What would the Royal Bank bond sell for if interest rates had dropped by 2 percent instead of rising by 2 percent? As you might guess, the bond would sell for more than $1,000. Such a bond is said to sell at a *premium* and is called a *premium bond.*

This case is just the opposite of a discount bond. The Royal Bank bond still has a coupon rate of 5.6 percent when the market rate is only 3.6 percent. Investors are willing to pay a premium to get this extra coupon. The relevant discount rate is 3.6 percent, and there are nine years remaining. The present value of the $1,000 face amount is:

$$\text{Present value} = \$1{,}000/1.036^9 = \$1{,}000/1.3748 = \$727.38$$

The present value of the coupon stream is:

$$\begin{aligned}\text{Annuity present value} &= \$56 \times (1 - 1/1.036^9)/.036\\ &= \$56 \times (1 - 1/1.3748)/.036\\ &= \$56 \times 7.5728\\ &= \$424.08\end{aligned}$$

We can now add the values for the two parts together to get the bond's value:

Total bond value = \$727.38 + 424.08 = \$1,151.46

Total bond value is, therefore, about \$151 in excess of par value. Once again, we can verify this amount by noting that the coupon is now \$20 too high. The present value of \$20 per year for nine years at 3.6 percent is:

$$\begin{aligned}\text{Annuity present value} &= \$20 \times (1 - 1/1.036^9/.036 \\ &= \$20 \times 7.5728 \\ &= \$151.46\end{aligned}$$

This is just as we calculated.

Based on our examples, we can now write the general expression for the value of a bond. If a bond has (1) a face value of F paid at maturity, (2) a coupon of C paid per period, (3) t periods to maturity, and (4) a yield of r per period, its value is:

$$\text{Bond value} = C \times (1 - 1/(1 + r)^t)/r + F/(1 + r)^t \qquad [7.1]$$

Bond value = Present value of the coupons + Present value of the face amount

As we have illustrated in this section, bond prices and interest rates (or market yields) always move in opposite directions like the ends of a seesaw. Most bonds are issued at par with the coupon rate set equal to the prevailing market yield or interest rate. This coupon rate does not change over time. The coupon yield, however, does change and reflects the return the coupon represents based on current market prices for the bond. Finally, the yield to maturity is the interest rate that equates the present value of the bond's coupons and principal repayments with the current market price (i.e., the total annual return the purchaser would receive if the bond were held to maturity).

When interest rates rise, a bond's value, like any other present value, declines. When interest rates are above the bond's coupon rate, the bond sells at a discount. Similarly, when interest rates fall, bond values rise. Interest rates below the bond's coupon rate cause the bond to sell at a premium. Even if we are considering a bond that is riskless in the sense that the borrower is certain to make all the payments, there is still risk in owning the bond. We discuss this next.

EXAMPLE 7.1: Semiannual Coupons

In practice, bonds issued in Canada usually make coupon payments twice a year. So, if an ordinary bond has a coupon rate of 8 percent, the owner gets a total of \$80 per year, but this \$80 comes in two payments of \$40 each. Suppose we were examining such a bond. The yield to maturity is quoted at 10 percent.

Bond yields are quoted like APRs; the quoted rate is equal to the actual rate per period multiplied by the number of periods. With a 10 percent quoted yield and semiannual payments, the true yield is 5 percent per six months. The bond matures in seven years. What is the bond's price? What is the effective annual yield on this bond?

Based on our discussion, we know the bond would sell at a discount because it has a coupon rate of 4 percent every six months when the market requires 5 percent every six months. So, if our answer exceeds \$1,000, we know that we made a mistake.

To get the exact price, we first calculate the present value of the bond's face value of \$1,000 paid in seven years. This seven years has 14 periods of six months each. At 5 percent per period, the value is:

$$\text{Present value} = \$1{,}000/1.05^{14} = \$1{,}000/1.9799 = \$505.08$$

The coupons can be viewed as a 14-period annuity of \$40 per period. At a 5 percent discount rate, the present value of such an annuity is:

$$\begin{aligned}\text{Annuity present value} &= \$40 \times (1 - 1/1.05^{14})/.05 \\ &= \$40 \times (1 - .5051)/.05 \\ &= \$40 \times 9.8980 \\ &= \$395.92\end{aligned}$$

The total present value gives us what the bond should sell for:

Total present value = \$505.08 + 395.92 = \$901.00

To calculate the effective yield on this bond, note that 5 percent every six months is equivalent to:

$$\text{Effective annual rate} = (1 + .05)^2 - 1 = 10.25\%$$

The effective yield, therefore, is 10.25 percent.

Interest Rate Risk

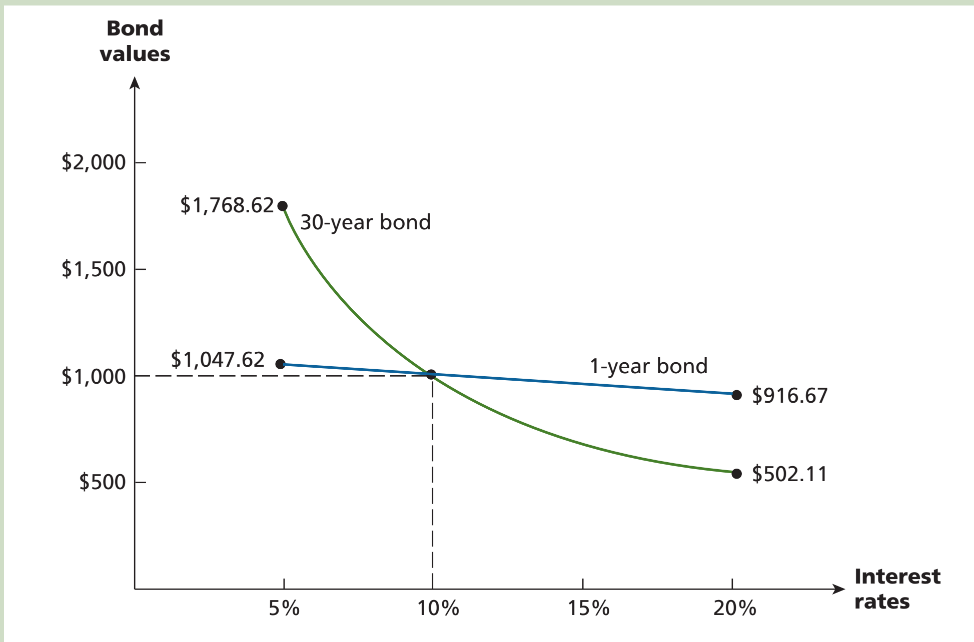
The risk that arises for bond owners from fluctuating interest rates (market yields) is called *interest rate risk.* How much interest risk a bond has depends on how sensitive its price is to interest rate changes. This sensitivity directly depends on two things: the time to maturity and the coupon rate. Keep the following in mind when looking at a bond:

1. All other things being equal, the longer the time to maturity, the greater the interest rate risk.
2. All other things being equal, the lower the coupon rate, the greater the interest rate risk.

We illustrate the first of these two points in Figure 7.2. As shown, we compute and plot prices under different interest rate scenarios for 10 percent coupon bonds with maturities of one year and 30 years. Notice how the slope of the line connecting the prices is much steeper for the 30-year maturity than it is for the one-year maturity.[1] This tells us that a relatively small change in interest rates could lead to a substantial change in the bond's value. In comparison, the one-year bond's price is relatively insensitive to interest rate changes.

Figure 7.2

Interest rate risk and time to maturity



Value of a Bond with a 10% Coupon Rate for Different Interest Rates and Maturities

	Time to Maturity	
Interest Rate	1 Year	30 Years
5%	$1,047.62	$1,768.62
10%	1,000.00	1,000.00
15%	956.52	671.70
20%	916.67	502.11

Intuitively, the reason that longer-term bonds have greater interest rate sensitivity is that a large portion of a bond's value comes from the $1,000 face amount. The present value of this

1 We explain a more precise measure of this slope, called duration, in Appendix 7A. Our example assumes that yields of one-year and 30-year bonds are the same

Table 7.1
Summary of bond valuation

I. FINDING THE VALUE OF A BOND:

Bond value = $C \times (1 - 1/(1 + r)^t)/r + F/(1 + r)^t$
where:
C = the coupon paid each period
r = the rate per period
t = the number of periods
F = the bond's face value

II. FINDING THE YIELD ON A BOND:

Given a bond value, coupon, time to maturity, and face value, it is possible to find the implicit discount rate or yield to maturity by trial and error only. To do this, try different discount rates until the calculated bond value equals the given value. Remember that increasing the rate decreases the bond value.

amount isn't greatly affected by a small change in interest rates if it is to be received in one year. If it is to be received in 30 years, however, even a small change in the interest rate can have a significant effect once it is compounded for 30 years. The present value of the face amount becomes much more volatile with a longer-term bond as a result.

The reason that bonds with lower coupons have greater interest rate risk is essentially the same. As we just discussed, the value of a bond depends on the present value of its coupons and the present value of the face amount. If two bonds with different coupon rates have the same maturity, the value of the one with the lower coupon is proportionately more dependent on the face amount to be received at maturity. As a result, all other things being equal, its value fluctuates more as interest rates change. Put another way, the bond with the higher coupon has a larger cash flow early in its life, so its value is less sensitive to changes in the discount rate.

Finding the Yield to Maturity

Frequently, we know a bond's price, coupon rate, and maturity date, but not its yield to maturity. For example, suppose we were interested in a six-year, 8 percent coupon bond. A broker quotes a price of $955.14. What is the yield on this bond?

We've seen that the price of a bond can be written as the sum of its annuity and lump-sum components. With an $80 coupon for six years and a $1,000 face value, this price is:

$$\$955.14 = \$80 \times (1 - 1/(1 + r)^6)/r + \$1{,}000/(1 + r)^6$$

where r is the unknown discount rate or yield to maturity. We have one equation here and one unknown, but we cannot solve it for r explicitly. The only way to find the answer exactly is to use trial and error.

This problem is essentially identical to the one we examined in the last chapter when we tried to find the unknown interest rate on an annuity. However, finding the rate (or yield) on a bond is even more complicated because of the $1,000 face amount.

We can speed up the trial-and-error process by using what we know about bond prices and yields: The bond has an $80 coupon and is selling at a discount. We thus know that the yield is greater than 8 percent. If we compute the price at 10 percent:

$$\begin{aligned} \text{Bond value} &= \$80 \times (1 - 1/1.10^6)/.10 + \$1{,}000/1.10^6 \\ &= \$80 \times (4.3553) + \$1{,}000/1.7716 \\ &= \$912.89 \end{aligned}$$

At 10 percent, the value we calculate is lower than the actual price, so 10 percent is too high. The true yield must be somewhere between 8 percent and 10 percent. At this point, it's "plug and chug" to find the answer. You would probably want to try 9 percent next. If you do, you will see that this is, in fact, the bond's yield to maturity. Our discussion of bond valuation is summarized in Table 7.1.

EXAMPLE 7.2: Bond Yields

You're looking at two bonds identical in every way except for their coupons and, of course, their prices. Both have 12 years to maturity. The first bond has a 10 percent coupon rate and sells for \$935.08. The second has a 12 percent coupon rate. What do you think it would sell for?

Because the two bonds are very similar, they are priced to yield about the same rate. We begin by calculating the yield on the 10 percent coupon bond. A little trial and error reveals that the yield is actually 11 percent:

$$\begin{aligned}\text{Bond value} &= \$100 \times (1 - 1/1.11^{12})/.11 + \$1{,}000/1.11^{12}\\ &= \$100 \times 6.4924 + \$1{,}000/3.4985\\ &= \$649.24 + 285.84\\ &= \$935.08\end{aligned}$$

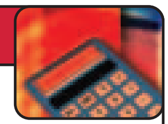
With an 11 percent yield, the second bond sells at a premium because of its \$120 coupon. Its value is:

$$\begin{aligned}\text{Bond value} &= \$120 \times (1 - 1/1.11^{12})/.11 + \$1{,}000/1.11^{12}\\ &= \$120 \times 6.4924 + \$1{,}000/3.4985\\ &= \$779.08 + 285.84\\ &= \$1{,}064.92\end{aligned}$$

What we did in pricing the second bond is what bond traders do. Bonds trade over the counter in a secondary market made by investment dealers and banks. Suppose a bond trader at, say, BMO Nesbitt Burns receives a request for a selling price on the second bond from another trader at, say, ScotiaCapital. Suppose further that the second bond has not traded recently. The trader prices it off the first actively traded bond.

www.bmonesbittburns.com

Calculator HINTS



How to Calculate Bond Prices and Yields Using a Financial Calculator

Many financial calculators have fairly sophisticated built-in bond valuation routines. However, these vary quite a lot in implementation, and not all financial calculators have them. As a result, we will illustrate a simple way to handle bond problems that will work on just about any financial calculator.

To begin, of course, we first remember to clear out the calculator! Next, for Example 7.2, we have two bonds to consider, both with 12 years to maturity. The first one sells for \$935.08 and has a 10 percent coupon rate. To find its yield, we can do the following:

	N	%i	PMT	PV	FV
Enter	12		100	–935.08	1,000
Solve for		11			

Notice that here we have entered both a future value of \$1,000, representing the bond's face value, and a payment of 10 percent of \$1,000, or \$100, per year, representing the bond's annual coupon. Also notice that we have a negative sign on the bond's price, which we have entered as the present value.

For the second bond, we now know that the relevant yield is 11 percent. It has a 12 percent coupon and 12 years to maturity, so what's the price? To answer, we just enter the relevant values and solve for the present value of the bond's cash flows:

	N	%i	PMT	PV	FV
Enter	12	11	120		1,000
Solve for		11		–1,064.92	

There is an important detail that comes up here. Suppose we have a bond with a price of \$902.29, 10 years to maturity, and a coupon rate of 6 percent. As we mentioned earlier, most bonds actually make semiannual payments. Assuming that this is the case for the

Calculator HINTS

bond here, what's the bond's yield? To answer, we need to enter the relevant numbers like this:

Enter	20		30	–902.29	1,000
	N	%i	PMT	PV	FV
Solve for		3.7			

Notice that we entered $30 as the payment because the bond actually makes payments of $30 every six months. Similarly, we entered 20 for N because there are actually 20 six-month periods. When we solve for the yield, we get 3.7 percent, but the tricky thing to remember is that this is the yield *per six months,* so we have to double it to get the right answer: 2 × 3.7 = 7.4 percent, which would be the bond's reported yield.

Spreadsheet STRATEGIES

How to Calculate Bond Prices and Yields Using a Spreadsheet

Most spreadsheets have fairly elaborate routines available for calculating bond values and yields; many of these routines involve details that we have not discussed. However, setting up a simple spreadsheet to calculate prices or yields is straightforward, as our next two spreadsheets show:

	A	B	C	D	E	F	G	H
1								
2	**Using a spreadsheet to calculate bond values**							
3								
4	Suppose we have a bond with 22 years to maturity, a coupon rate of 8 percent, and a yield to							
5	maturity of 9 percent. If the bond makes semiannual payments, what is its price today?							
6								
7	Settlement date:	1/1/00						
8	Maturity date:	1/1/22						
9	Annual coupon rate:	0.08						
10	Yield to maturity:	.09						
11	Face value (% of par):	100						
12	Coupons per year:	2						
13	Bond price (% of par):	**90.49**						
14								
15	The formula entered in cell B13 is =PRICE(B7,B8,B9,B10,B11,B12); notice that face value and bond							
16	price are given as a percentage of face value.							

In our spreadsheets, notice that we had to enter two dates, a settlement date and a maturity date. The settlement date is just the date you actually pay for the bond, and the maturity date is the day the bond actually matures. In most of our problems, we don't explicitly have these dates, so we have to make them up. For example, since our bond has 22 years to maturity, we just picked 1/1/2000 (January 1, 2000) as the settlement date and 1/1/2022 (January 1, 2022) as the maturity date. Any two dates would do as long as they are exactly 22 years apart, but these are particularly easy to work with. Finally, notice that we had to enter the coupon rate and yield to maturity in annual terms and then explicitly provide the number of coupon payments per year.

Spreadsheet STRATEGIES

	A	B	C	D	E	F	G	H
1								
2	**Using a spreadsheet to calculate bond yields**							
3								
4	Suppose we have a bond with 22 years to maturity, a coupon rate of 8 percent, and a price of							
5	$960.17. If the bond makes semiannual payments, what is its yield to maturity?							
6								
7	Settlement date:	1/1/00						
8	Maturity date:	1/1/22						
9	Annual coupon rate:	0.08						
10	Bond price (% of par):	96.017						
11	Face value (% of par):	100						
12	Coupons per year:	2						
13	Yield to maturity:	**0.084**						
14								
15	The formula entered in cell b13 is =YIELD(B7,B8,B9,B10,B11,B12); notice that face value and bond							
16	price are entered as a percentage of face value.							

7.2 MORE ON BOND FEATURES

In this section, we continue our discussion of corporate debt by describing in some detail the basic terms and features that make up a typical long-term corporate bond. We discuss additional issues associated with long-term debt in subsequent sections.

Securities issued by corporations may be classified roughly as *equity securities* and *debt securities*. At the crudest level, a debt represents something that must be repaid; it is the result of borrowing money. When corporations borrow, they generally promise to make regularly scheduled interest payments and to repay the original amount borrowed (that is, the principal). The person or firm making the loan is called the *creditor,* or *lender*. The corporation borrowing the money is called the *debtor,* or *borrower.*

From a financial point of view, the main differences between debt and equity are the following:

1. Debt is not an ownership interest in the firm. Creditors generally do not have voting power.
2. The corporation's payment of interest on debt is considered a cost of doing business and is fully tax deductible. Dividends paid to shareholders are *not* tax deductible.
3. Unpaid debt is a liability of the firm. If it is not paid, the creditors can legally claim the assets of the firm. This action can result in liquidation or reorganization, two of the possible consequences of bankruptcy. Thus, one of the costs of issuing debt is the possibility of financial failure. This possibility does not arise when equity is issued.

Is It Debt or Equity?

Sometimes it is not clear if a particular security is debt or equity. For example, suppose a corporation issues a perpetual bond with interest payable solely from corporate income if and only if earned. Whether or not this is really a debt is hard to say and is primarily a legal and semantic issue. Courts and taxing authorities would have the final say.

Corporations are very adept at creating exotic, hybrid securities that have many features of equity but are treated as debt. Obviously, the distinction between debt and equity is very important for tax purposes. So one reason that corporations try to create a debt security that is really equity is to obtain the tax benefits of debt and the bankruptcy benefits of equity.

As a general rule, equity represents an ownership interest, and it is a residual claim. This means that equity holders are paid after debt holders. As a result of this, the risks and benefits associated with owning debt and equity are different. To give just one example, note that the maximum reward for owning a debt security is ultimately fixed by the amount of the loan, whereas there is no upper limit to the potential reward from owning an equity interest.

Long-Term Debt: The Basics

Ultimately, all long-term debt securities are promises by the issuing firm to pay the principal when due and to make timely interest payments on the unpaid balance. Beyond this, a number of features distinguish these securities from one another. We discuss some of these features next.

The maturity of a long-term debt instrument refers to the length of time the debt remains outstanding with some unpaid balance. Debt securities can be short-term (maturities of one year or less) or long-term (maturities of more than one year).[2]

Debt securities are typically called *notes, debentures,* or *bonds*. Strictly speaking, a bond is a secured debt, but, in common usage, the word bond refers to all kinds of secured and unsecured debt. We use the term generically to refer to long-term debt.

The two major forms of long-term debt are public-issue and privately placed. We concentrate on public-issue bonds. Most of what we say about them holds true for private-issue, long-term debt as well. The main difference between public-issue and privately placed debt is that the latter is directly placed with a lender and not offered to the public. Since this is a private transaction, the specific terms are up to the parties involved.

There are many other dimensions to long-term debt, including such things as security, call features, sinking funds, ratings, and protective covenants. The following table illustrates these features for a Loblaw Companies Limited medium term note issued in March 2002. If some of these terms are unfamiliar, have no fear. We discuss them all next.

www.sedar.com

Features of Loblaw Companies—Medium Term Notes (unsecured) issue

Terms		Explanation
Amount of issue	$200 million	The company will issue $200 million of bonds
Issue date	3/1/02	The bonds will be sold on March 3, 2002.
Maturity date	3/1/32	The bonds will be paid in 30 years.
Face value	$1,000	The denomination of the bonds is $1,000.
Annual coupon	6.85	Each bondholder will receive $68.50 per bond per year.
Issue price	99.697	The issue price will be 99.697% of the $1,000 face value per bond.
Yield to maturity	6.87%	If the bond is held to maturity, bondholders will receive a stated annual rate of return equal to 6.87%.
Coupon payment	3/1 and 9/1	Coupons of $68.50/2 = $34.25 will be paid semi-annually on these dates.
Security	Unsecured	The bonds are debentures.
Call provision	Canada Yield Price at Canada plus 0.26%	Redeemable at the Company' option at the price calculated to provide a yield to maturity equal to Canada yield or equivalent maturity plus 0.26%.
Rating	DBRS A	The bond is of satisfactory credit quality, but is not as high as AA.

Source: *www.sedar.com*

Many of these features are detailed in the bond indenture, so we discuss this now.

The Indenture

indenture
Written agreement between the corporation and the lender detailing the terms of the debt issue.

The **indenture** is the written agreement between the corporation (the borrower) and its creditors. It is sometimes referred to as the deed of trust.[3] Usually, a trustee (a trust company) is appointed by the corporation to represent the bondholders. The trust company must (1) make sure the terms of the indenture are obeyed, (2) manage the sinking fund (described later), and

2 There is no universally agreed-upon distinction between short-term and long-term debt. In addition, people often refer to intermediate-term debt, which has a maturity of more than 1 year and less than 3 to 5, or even 10, years.

3 The words *loan agreement* or *loan contract* are usually used for privately placed debt and term loans.

(3) represent the bondholders in default, that is, if the company defaults on its payments to them.

The bond indenture is a legal document. It can run several hundred pages and generally makes for very tedious reading. It is an important document, however, because it generally includes the following provisions:

1. The basic terms of the bonds.
2. The amount of the bonds issued.
3. A description of property used as security if the bonds are secured.
4. The repayment arrangements.
5. The call provisions.
6. Details of the protective covenants.

We discuss these features next.

TERMS OF A BOND Corporate bonds usually have a face value (that is, a denomination) of $1,000. This is called the *principal value,* and it is stated on the bond certificate. So, if a corporation wanted to borrow $1 million, 1,000 bonds would have to be sold. The par value (that is, initial accounting value) of a bond is almost always the same as the face value.

registered form
Registrar of company records ownership of each bond; payment is made directly to the owner of record.

Corporate bonds are usually in **registered form.** For example, the indenture might read as follows: Interest is payable semiannually on July 1 and January 1 of each year to the person in whose name the bond is registered at the close of business on June 15 or December 15, respectively.

This means the company has a registrar who records the ownership of each bond and records any changes in ownership. The company pays the interest and principal by cheque mailed directly to the address of the owner of record. A corporate bond may be registered and may have attached coupons. To obtain an interest payment, the owner must separate a coupon from the bond certificate and send it to the company registrar (the paying agent).

bearer form
Bond issued without record of the owner's name; payment is made to whoever holds the bond.

Alternatively, the bond could be in **bearer form.** This means the certificate is the basic evidence of ownership, and the corporation pays the bearer. Ownership is not otherwise recorded, and, as with a registered bond with attached coupons, the holder of the bond certificate detaches the coupons and sends them to the company to receive payment.

There are two drawbacks to bearer bonds: First, they are difficult to recover if they are lost or stolen. Second, because the company does not know who owns its bonds, it cannot notify bondholders of important events. The bearer form of ownership does have the advantage of easing transactions for investors who trade their bonds frequently.

SECURITY Debt securities are classified according to the collateral and mortgages used to protect the bondholder.

Collateral is a general term that, strictly speaking, means securities (for example, bonds and stocks) pledged as security for payment of debt. For example, collateral trust bonds often involve a pledge of common stock held by the corporation. This pledge is usually backed by marketable securities. However, the term *collateral* often is used much more loosely to refer to any form of security.

Mortgage securities are secured by a mortgage on the real property of the borrower. The property involved may be real estate, transportation equipment, or other property. The legal document that describes a mortgage on real estate is called a mortgage trust indenture or trust deed.

Sometimes mortgages are on specific property, for example, a railroad car. This is called a chattel mortgage. More often, blanket mortgages are used. A blanket mortgage pledges all the real property owned by the company.[4]

debenture
Unsecured debt, usually with a maturity of 10 years or more.

note
Unsecured debt, usually with a maturity under 10 years.

Bonds frequently represent unsecured obligations of the company. A **debenture** is an unsecured bond, where no specific pledge of property is made. The term **note** is generally used for such instruments if the maturity of the unsecured bond is less than 10 or so years when it is originally issued. Debenture holders only have a claim on property not otherwise pledged; in other words, the property that remains after mortgages and collateral trusts are taken into account.

4 Real property includes land and things "affixed thereto." It does not include cash or inventories.

At the current time, most public bonds issued by industrial and finance companies are debentures. However, most utility and railroad bonds are secured by a pledge of assets.

SENIORITY In general terms, *seniority* indicates preference in position over other lenders, and debts are sometimes labelled as "senior" or "junior" to indicate seniority. Some debt is *subordinated,* as in, for example, a subordinated debenture.

In the event of default, holders of subordinated debt must give preference to other specified creditors. Usually, this means the subordinated lenders are paid off from cash flow and asset sales only after the specified creditors have been compensated. However, debt cannot be subordinated to equity.

REPAYMENT Bonds can be repaid at maturity, at which time the bondholder receives the stated or face value of the bonds, or they may be repaid in part or in entirety before maturity. Early repayment in some form is more typical and is often handled through a sinking fund.

sinking fund
Account managed by the bond trustee for early bond redemption.

A **sinking fund** is an account managed by the bond trustee for the purpose of repaying the bonds. The company makes annual payments to the trustee, who then uses the funds to retire a portion of the debt. The trustee does this by either buying up some of the bonds in the market or calling in a fraction of the outstanding bonds. We discuss this second option in the next section.

There are many different kinds of sinking fund arrangements. The fund may start immediately or be delayed for 10 years after the bond is issued. The provision may require the company to redeem all or only a portion of the outstanding issue before maturity. From an investor's viewpoint, a sinking fund reduces the risk that the company will be unable to repay the principal at maturity. Since it involves regular purchases, a sinking fund improves the marketability of the bonds.

call provision
Agreement giving the corporation the option to repurchase the bond at a specified price before maturity.

call premium
Amount by which the call price exceeds the par value of the bond.

deferred call
Call provision prohibiting the company from redeeming the bond before a certain date.

call protected
Bond during period in which it cannot be redeemed by the issuer.

Canada plus call
Call provision which compensates bond investors for interest differential making call unattractive for issuer.

protective covenant
Part of the indenture limiting certain transactions that can be taken during the term of the loan, usually to protect the lender's interest.

THE CALL PROVISION A **call provision** allows the company to repurchase or "call" part or all of the bond issue at stated prices over a specified period. Corporate bonds are usually callable.

Generally, the call price is more than the bond's stated value (that is, the par value). The difference between the call price and the stated value is the **call premium.** The call premium may also be expressed as a percentage of the bond's face value. The amount of the call premium usually becomes smaller over time. One arrangement is to initially set the call premium equal to the annual coupon payment and then make it decline to zero the closer the call date is to maturity.

Call provisions are not usually operative during the first part of a bond's life. This makes the call provision less of a worry for bondholders in the bond's early years. For example, a company might be prohibited from calling its bonds for the first 10 years. This is a **deferred call.** During this period, the bond is said to be **call protected.**

Many long-term corporate bonds outstanding in Canada have call provisions as we just described. New corporate debt features a different call provision referred to as a **Canada plus call.** This new approach is designed to replace the traditional call feature by making it unattractive for the issuer ever to call the bonds. Unlike the standard call, with the Canada call the exact amount of the call premium is not set at the time of issuance. Instead, the Canada plus call stipulates that, in the event of a call, the issuer must provide a call premium which will compensate investors for the difference in interest between the original bond and new debt issued to replace it. This compensation cancels the borrower's benefit from calling the debt and the result is that call will not occur.

The Canada plus call takes its name from the formula used to calculate the difference in the interest; to determine the new, lower interest rate, the formula adds a premium to the yield on Canadas. We give a numerical example of a Canada plus call in Appendix 7B, which discusses call provisions and refunding in detail.

PROTECTIVE COVENANTS A **protective covenant** is that part of the indenture or loan agreement that limits certain actions a company might otherwise wish to take during the term of the loan. Covenants are designed to reduce the agency costs faced by bondholders. By controlling company activities, they reduce the risk of the bonds.

For example, common covenants limit the dividends the firm can pay and require bondholder approval for any sale of major assets. This means that, if the firm is headed for bankruptcy, it cannot sell all the assets and pay a liquidating dividend to stockholders leaving the bondholders with only a corporate shell. Protective covenants can be classified into two types: negative covenants and positive (or affirmative) covenants.

A *negative covenant* is a "thou shalt not." It limits or prohibits actions that the company may take. Here are some typical examples:

1. The firm must limit the amount of dividends it pays according to some formula.
2. The firm cannot pledge any assets to other lenders.
3. The firm cannot merge with another firm.
4. The firm cannot sell or lease any major assets without approval by the lender.
5. The firm cannot issue additional long-term debt.

A *positive covenant* is a "thou shalt." It specifies an action that the company agrees to take or a condition the company must abide by. Here are some examples:

1. The company must maintain its working capital at or above some specified minimum level.
2. The company must periodically furnish audited financial statements to the lender.
3. The firm must maintain any collateral or security in good condition.

This is only a partial list of covenants; a particular indenture may feature many different ones.

CONCEPT QUESTIONS

1. What are the distinguishing features of debt as compared to equity?
2. What is the indenture? What are protective covenants? Give some examples.
3. What is a sinking fund?

7.3 BOND RATINGS

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www.sandp.com

Firms frequently pay to have their debt rated. The two leading bond rating firms in Canada are Standard & Poor's (S&P) and Dominion Bond Rating Service (DBRS). Moody's and Standard & Poor's (S&P) are the largest U.S. bond raters and they often rate Canadian companies that raise funds in U.S. bond markets.[5] The debt ratings are an assessment of the creditworthiness of the corporate issuer. The definitions of creditworthiness used by bond rating agencies are based on how likely the firm is to default and the protection creditors have in the event of a default.

Remember that bond ratings only concern the possibility of default. Earlier in this chapter, we discussed interest rate risk, which we defined as the risk of a change in the value of a bond from a change in interest rates. Bond ratings do not address this issue. As a result, the price of a highly rated bond can still be quite volatile.

Bond ratings are constructed from information supplied by the corporation. The rating classes and information concerning them are shown in Table 7.2. Table 7.2 shows ratings by DBRS. Standard & Poor's follows a similar system.

The highest rating a firm can have is AAA and such debt is judged to be the best quality and to have the lowest degree of risk. This rating is not awarded very often; AA ratings indicate very good quality debt and are much more common. Investment grade bonds are bonds rated at least BBB. The lowest ratings are for debt that is in default.

In the 1980s, a growing part of corporate borrowing took the form of low-grade, or junk, bonds particularly in the United States. If they are rated at all, such low-grade bonds are rated below investment grade by the major rating agencies. Junk bonds are also called *high-yield* bonds as they yield an interest rate 3 to 5 percentage points (300 to 500 basis points) higher than that of AAA-rated debt. Original issue junk bonds have never been a major source of funds in Canadian capital markets. Their niche has been filled in part by preferred shares and to a lesser extent, income bonds. In recent years, some Canadian corporations with large debt financing needs have issued bonds below investment grade. For example, at the time of writing, Rogers Communications Inc. (RCI) had a Standard & Poor's corporate credit rating of BB+.

www.rogers.com

5 They also rate bonds issued by the individual provinces.

Table 7.2
Descriptions of ratings used by Dominion Bond Rating Service

AAA	Bonds rated AAA are of the highest credit quality, with exceptionally strong protection for the timely repayment of principal and interest. Earnings are considered stable, the structure of the industry in which the entity operates is strong, and the outlook for future profitability is favourable. There are few qualifying factors present which would detract from the performance of the entity, the strength of liquidity and coverage ratios is unquestioned and the entity has established a creditable track record of superior performance. Given the extremely tough definition which DBRS has established for this category, few entities are able to achieve a AAA rating.
AA	Bonds rated AA are of superior credit quality, and protection of interest and principal is considered high. In many cases, they differ from bonds rated AAA only to a small degree. Given the extremely tough definition which DBRS has for the AAA category (which few companies are able to achieve), entities rated AA are also considered to be strong credits which typically exhibit above average strength in key areas of consideration and are unlikely to be significantly affected by reasonably foreseeable events.
A	Bonds rated A are of satisfactory credit quality. Protection of interest and principal is still substantial, but the degree of strength is less than with AA rated entities. While a respectable rating, entities in the A category are considered to be more susceptible to adverse economic conditions and have greater cyclical tendencies than higher rated companies.
BBB	Bonds rated BBB are of adequate credit quality. Protection of interest and principal is considered adequate, but the entity is more susceptible to adverse changes in financial and economic conditions, or there may be other adversities present which reduce the strength of the entity and its rated securities.
BB	Bonds rated BB are defined to be speculative, where the degree of protection afforded interest and principal is uncertain, particularly during periods of economic recession. Entities in the BB area typically have limited access to capital markets and additional liquidity support, and in many cases, small size or lack of competitive strength may be additional negative considerations.
B	Bonds rated B are highly speculative and there is a reasonably high level of uncertainty as to the ability of the entity to pay interest and principal on a continuing basis in the future, especially in periods of economic recession or industry adversity.
CCC	Bonds rated CCC are very highly speculative. The degree of adverse elements present is more severe than bonds rated B. Bonds rated CCC often have characteristics which, if not remedied, may lead to default.
CC	Bonds rated CC are extremely speculative. These bonds are in danger of default of interest and/or principal. Bonds rated CC have characteristics which, if not remedied, will lead to default.
C	Bonds rated C are extremely speculative and are in immediate danger of default. This is the lowest rating category provided to long term instruments that are not in default.
D	Bonds rated D are currently in default of interest, principal, or both.

Source: © 2002 Dominion Bond Rating Service Limited, *www.dbrs.com,* used with permission.

CONCEPT QUESTIONS

1. What is a junk bond?
2. What does a bond rating say about the risk of fluctuations in a bond's value from interest rate changes?

7.4 SOME DIFFERENT TYPES OF BONDS

Thus far, we have considered "plain vanilla" bonds. In this section, we look at some more unusual types, the products of financial engineering: stripped bonds, floating-rate bonds, and others.

Financial Engineering

When financial managers or their investment bankers design new securities or financial processes, their efforts are referred to as financial engineering.[6] Successful financial engineering reduces and controls risk and minimizes taxes. It also seeks to reduce financing costs of issuing and servicing debt as well as costs of complying with rules laid down by regulatory authorities.

6 For more on financial engineering, see John Finnerty, "Financial Engineering in Corporate Finance: An Overview," in *The Handbook of Financial Engineering,* eds. C. W. Smith and C. W. Smithson (New York: Harper Business, 1990).

In Their Own Words . . .

Edward I. Altman on Junk Bonds

ONE OF THE most important developments in corporate finance over the last 20 years has been the reemergence of publicly owned and traded low-rated corporate debt. Originally offered to the public in the early 1900s to help finance some of our emerging growth industries, these high-yield, high-risk bonds virtually disappeared after the rash of bond defaults during the Depression. Recently, however, the junk bond market has been catapulted from being an insignificant element in the corporate fixed-income market to being one of the fastest-growing and most controversial types of financing mechanisms.

The term *junk* emanates from the dominant type of low-rated bond issues outstanding prior to 1977 when the "market" consisted almost exclusively of original-issue investment-grade bonds that fell from their lofty status to a higher–default risk, speculative-grade level. These so-called fallen angels amounted to about $8.5 billion in 1977. At the end of 1998, fallen angels comprised about 10 percent of the $450 billion publicly owned junk bond market.

Beginning in 1977, issuers began to go directly to the public to raise capital for growth purposes. Early users of junk bonds were energy-related firms, cable TV companies, airlines, and assorted other industrial companies. The emerging growth company rationale coupled with relatively high returns to early investors helped legitimize this sector.

By far the most important and controversial aspect of junk bond financing was its role in the corporate restructuring movement from 1985 to 1989. High-leverage transactions and acquisitions, such as leveraged buyouts (LBOs), which occur when a firm is taken private, and leveraged recapitalizations (debt-for-equity swaps), transformed the face of corporate America, leading to a heated debate as to the economic and social consequences of firms' being transformed with debt-equity ratios of at least 6:1.

These transactions involved increasingly large companies, and the multibillion-dollar takeover became fairly common, finally capped by the huge $25+ billion RJR Nabisco LBO in 1989. LBOs were typically financed with about 60 percent senior bank and insurance company debt, about 25–30 percent subordinated public debt (junk bonds), and 10–15 percent equity. The junk bond segment is sometimes referred to as "mezzanine" financing because it lies between the "balcony" senior debt and the "basement" equity.

These restructurings resulted in huge fees to advisors and underwriters and huge premiums to the old shareholders who were bought out, and they continued as long as the market was willing to buy these new debt offerings at what appeared to be a favorable risk-return trade-off. The bottom fell out of the market in the last six months of 1989 due to a number of factors including a marked increase in defaults, government regulation against S&Ls' holding junk bonds, and a recession.

The default rate rose dramatically to 4 percent in 1989 and then skyrocketed in 1990 and 1991 to 10.1 percent and 10.3 percent, respectively, with about $19 billion of defaults in 1991. By the end of 1990, the pendulum of growth in new junk bond issues and returns to investors swung dramatically downward as prices plummeted and the new-issue market all but dried up. The year 1991 was a pivotal year in that, despite record defaults, bond prices and new issues rebounded strongly as the prospects for the future brightened.

In the early 1990s, the financial market was questioning the very survival of the junk bond market. The answer was a resounding "yes," as the amount of new issues soared to record annual levels of $40 billion in 1992 and almost $60 billion in 1993, and in 1997 reached an impressive $119 billion. Coupled with plummeting default rates (under 2.0 percent each year in the 1993–97 period) and attractive returns in these years, the risk-return characteristics have been extremely favorable.

The junk bond market today is a quieter one compared to that of the 1980s, but, in terms of growth and returns, it is healthier than ever before. While the low default rates in 1992–98 helped to fuel new investment funds and new issues, the market will experience its ups and downs in the future. It will continue, however, to be a major source of corporate debt financing and a legitimate asset class for investors.

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Financial engineering is a response to the trends we discussed in Chapter 1, globalization, deregulation, and greater competition in financial markets.

When applied to debt securities, financial engineering creates exotic, hybrid securities that have many features of equity but are treated as debt. For example, suppose a corporation issues a perpetual bond with interest payable solely from corporate income if, and only if, earned. Whether this is really a debt or not is hard to say and is primarily a legal and semantic issue. Courts and taxing authorities would have the final say.

Obviously, the distinction between debt and equity is very important for tax purposes. So one reason that corporations try to create a debt security that is really equity is to obtain the tax benefits of debt and the bankruptcy benefits (lower agency costs) of equity.

As a general rule, equity represents an ownership interest, and it is a residual claim. This means equity holders are paid after debtholders. As a result of this, the risks and benefits associated with owning debt and equity are different. To give just one example, the maximum reward for owning a straight debt security is ultimately fixed by the amount of the loan, whereas there is no necessary upper limit to the potential reward from owning an equity interest.

Financial engineers can alter this division of claims by selling bonds with *warrants* attached giving bondholders options to buy stock in the firm. These warrants allow holders to participate in future rewards beyond the face value of the debt. We discuss other examples of financial engineering throughout this chapter.

Stripped Bonds

stripped bond/zero-coupon bond
A bond that makes no coupon payments, thus initially priced at a deep discount.

A bond that pays no coupons must be offered at a price that is much lower that its stated value. Such bonds are called **stripped bonds** or **zero-coupon bonds.**[7] Stripped bonds start life as normal coupon bonds. Investment dealers engage in bond stripping when they sell the principal and coupons separately.

Suppose the DDB Company issues a $1,000 face value five-year stripped bond. The initial price is set at $497. It is straightforward to check that, at this price, the bonds yield 15 percent to maturity. The total interest paid over the life of the bond is $1,000 – 497 = $503.

For tax purposes, the issuer of a stripped bond deducts interest every year even though no interest is actually paid. Similarly, the owner must pay taxes on interest accrued every year as well, even though no interest is actually received.[8] This second tax feature makes taxable stripped bonds less attractive to taxable investors. However, they are still a very attractive investment for tax-exempt investors with long-term dollar-denominated liabilities, such as pension funds, because the future dollar value is known with relative certainty. Stripped coupons are attractive to individual investors for tax-sheltered registered retirement savings plans (RRSPs).

Floating-Rate Bonds

The conventional bonds we have talked about in this chapter have fixed-dollar obligations because the coupon rate is set as a fixed percentage of the par value. Similarly, the principal is set equal to the par value. Under these circumstances, the coupon payment and principal are fixed.

With *floating-rate bonds (floaters),* the coupon payments are adjustable. The adjustments are tied to the Treasury bill rate or another short-term interest rate. For example, the Royal Bank has outstanding $250 million of floating-rate notes maturing in 2083. The coupon rate is set at 0.40 percent more than the bankers acceptance rate.

Floating rate bonds were introduced to control the risk of price fluctuations as interest rates change. A bond with a coupon equal to the market yield is priced at par. In practice, the value of a floating-rate bond depends on exactly how the coupon payment adjustments are defined.

7 A bond issued with a very low coupon rate (as opposed to a zero coupon rate) is an original issue, discount (OID) bond.

8 The way the yearly interest on a stripped bond is calculated is governed by tax law and is not necessarily the true compound interest.

In most cases, the coupon adjusts with a lag to some base rate, and so the price can deviate from par within some range. For example, suppose a coupon-rate adjustment is made on June 1. The adjustment might be based on the simple average of Treasury bill yields during the previous three months. In addition, the majority of floaters have the following features:

1. The holder has the right to redeem his or her note at par on the coupon payment date after some specified amount of time. This is called a put provision, and it is discussed later.
2. The coupon rate has a floor and a ceiling, meaning the coupon is subject to a minimum and a maximum.

Other Types of Bonds

Many bonds have unusual or exotic features. So-called disaster bonds provide an interesting example. In 1996, USAA, a big seller of car and home insurance based in San Antonio, Texas, announced plans to issue $500 million in "act of God" bonds. The way these work is that USAA will pay interest and principal in the usual way unless it has to cover more than $1 billion in hurricane claims from a single storm over any single one-year period. If this happens, investors stand to lose both principal and interest.

A similar issue was being planned by the proposed California Earthquake Authority, a public agency whose purpose would be to alleviate a growing home insurance availability crunch in the state. The issue, expected to be about $3.35 billion, would have a 10-year maturity, and investors would risk interest paid in the first 4 years in the event of a catastrophic earthquake.

As these examples illustrate, bond features are really only limited by the imaginations of the parties involved. Unfortunately, there are far too many variations for us to cover in detail here. We therefore close out this discussion by mentioning only a few of the more common types.

Income bonds are similar to conventional bonds, except that coupon payments are dependent on company income. Specifically, coupons are paid to bondholders only if the firm's income is sufficient. In Canada, income bonds are usually issued by firms in the process of reorganization to try to overcome financial distress. The firm can skip the interest payment on an income bond without being in default. Purchasers of income bonds receive favourable tax treatment on interest received. *Real return bonds* have coupons and principal indexed to inflation to provide a stated real return. In 1993, the federal government issued a *stripped real return bond* packaging inflation protection in the form of a zero coupon bond.

A *convertible bond* can be swapped for a fixed number of shares of stock anytime before maturity at the holder's option. Convertibles are debt/equity hybrids that allow the holder to profit if the issuer's stock price rises.

retractable bond
Bond that may be sold back to the issuer at a prespecified price before maturity.

A **retractable bond** or *put bond* allows the holder to force the issuer to buy the bond back at a stated price. As long as the issuer remains solvent, the put feature sets a floor price for the bond. It is, therefore, just the reverse of the call provision and is a relatively new development. We discuss convertible bonds, call provisions, and put provisions in more detail in Chapter 25.

A given bond may have many unusual features. To give just one example, Merrill Lynch created a popular bond called a *liquid yield option note,* or LYON ("lion"). A LYON has everything but the "kitchen sink"; this bond is a callable, puttable, convertible, zero coupon, subordinated note. In 1991, Rogers Communications Inc. issued the first LYON in Canada. Valuing a bond of this sort can be quite complex:

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CONCEPT QUESTIONS

1. Why might an income bond be attractive to a corporation with volatile cash flows? Can you think of a reason why income bonds are not more popular?
2. What do you think the effect of a put feature on a bond's coupon would be? How about a convertibility feature? Why?

7.5 BOND MARKETS

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Bonds are bought and sold in enormous quantities every day. You may be surprised to learn that the trading volume in bonds on a typical day is many, many times larger than the trading volume in stocks (by trading volume, we simply mean the amount of money that changes hands). Here is a finance trivia question: What is the largest securities market in the world? Most people would guess the New York Stock Exchange. As if! In fact, the largest securities market in the world in terms of trading volume is the U.S. Treasury market.

How Bonds Are Bought and Sold

As we mentioned all the way back in Chapter 1, most trading in bonds takes place over the counter, or OTC. Recall that this means that there is no particular place where buying and selling occur. Instead, dealers around the country (and around the world) stand ready to buy and sell. The various dealers are connected electronically.

One reason the bond markets are so big is that the number of bond issues far exceeds the number of stock issues. A corporation would typically have only one common stock issue outstanding (there are exceptions to this that we discuss in our next chapter). However, a single large corporation could easily have a dozen or more note and bond issues outstanding.

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Because the bond market is almost entirely OTC, it has little or no *transparency.* A financial market is transparent if it is possible to easily observe its prices and trading volume. On the Toronto Stock Exchange, for example, it is possible to see the price and quantity for every single transaction. In contrast, in the bond market, it is usually not possible to observe either. Transactions are privately negotiated between parties, and there is little or no centralized reporting of transactions.

Although the total volume of trading in bonds far exceeds that in stocks, only a very small fraction of the total bond issues that exist actually trade on a given day. This fact, combined with the lack of transparency in the bond market, means that getting up-to-date prices on individual bonds is often difficult or impossible, particularly for smaller corporate or municipal issues. Instead, a variety of sources of estimated prices exist and are very commonly used.

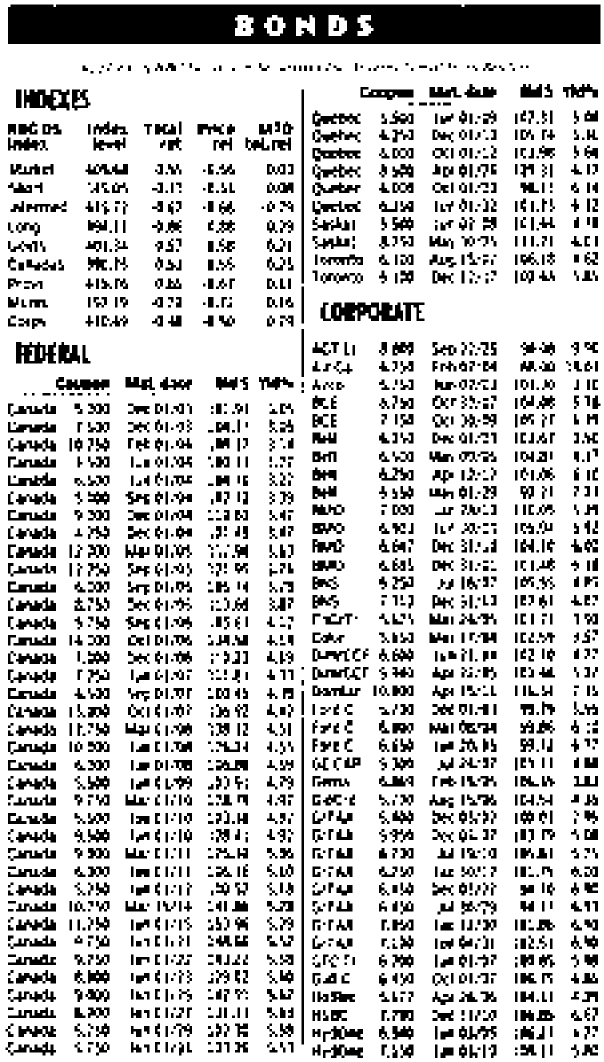
Bond Price Reporting

If you were to look at the *National Post* (or similar financial newspaper), you would see information on various bonds issued by the Government of Canada, the provinces and provincial crown corporations, and large corporations. Figure 7.3 reproduces excerpts from the bond quotations on November 29, 2002. If you look down the list under "Corporate", you come to an entry marked "BMO 7.000 Jan28/10". This tells us the bond was issued by Bank of Montreal and it will mature on January 28, 2010. The 7.000 is the bond's coupon rate, so the coupon is 7.000 percent of the face value. Assuming the face value is $1000, the annual coupon on this bond is $.07 \times \$1000 = \$70.00$.

The column marked Bid $ gives us the last available bid price on the bond at close of business the day before. This price was supplied by RBC Dominion Securities. As with the coupon, the price is quoted as a percentage of face value; so, again assuming a face value of $1,000, this bond last sold for 110.05 percent of $1,000 or $1100.50. Because this bond is selling for about 110.05 percent of its par value, it is trading at a premium. The last column marked Yld% gives the going market yield to maturity on the BMO bond as 5.29 percent. This yield is lower than the coupon rate of 7.000 percent, which explains why the bond is selling above its par value. The market yield is below the coupon rate by 1.71 percent, or 171 basis points. (In bond trader's jargon, one basis point equals 1/100 of 1 percent.) This causes the price premium to be above par.

Figure 7.3

Sample bond quotations



Source: *National Post,* November 29, 2002, p. C19. Used with permission.

EXAMPLE 7.3: Bond Pricing in Action

Investment managers who specialize in bonds use bond pricing principles to try to make money for their clients by buying bonds whose prices they expect to rise. An interest rate anticipation strategy starts with a forecast for the level of interest rates. Such forecasts are extremely difficult to make consistently. In Chapter 12, we discuss in detail how difficult it is to beat the market.

Suppose a manager had predicted a significant drop in interest rates in 2000. How should such a manager have invested?

This manager would have invested heavily in bonds with the greatest price sensitivity; that is, in bonds whose prices would rise the most as rates fell. Based on the earlier discussion, you should recall that such price-sensitive bonds have longer times to maturity and low coupons.

Suppose you wanted to bet on the expectation that interest rates were going to fall significantly using the bond quotations in Figure 7.3. Suppose further that your client wanted to invest only in Government of Canada bonds. Which would you buy?

CONCEPT QUESTIONS

1. What are the cash flows associated with a bond?
2. What is the general expression for the value of a bond?
3. Is it true that the only risk associated with owning a bond is that the issuer will not make all the payments? Explain.
4. Figure 7.3 shows two Canada bonds both maturing on September 1, 2005. These bonds are both issued by the Government of Canada and they have identical maturities. Why do they have different yields?

7.6 INFLATION AND INTEREST RATES

So far, we haven't considered the role of inflation in our various discussions of interest rates, yields, and returns. Because this is an important consideration, we consider the impact of inflation next.

Real versus Nominal Rates

nominal rates
Interest rates or rates of return that have not been adjusted for inflation.

real rates
Interest rates or rates of return that have been adjusted for inflation.

In examining interest rates, or any other financial market rates such as discount rates, bond yields, rates of return, and required returns, it is often necessary to distinguish between **real rates** and **nominal rates.** Nominal rates are called "nominal" because they have not been adjusted for inflation. Real rates are rates that have been adjusted for inflation.

To see the effect of inflation, suppose prices are currently rising by 5 percent per year. In other words, the rate of inflation is 5 percent. An investment is available that will be worth $115.50 in one year. It costs $100 today. Notice that with a present value of $100 and a future value in one year of $115.50, this investment has a 15.5 percent rate of return. In calculating this 15.5 percent return, we did not consider the effect of inflation, however, so this is the nominal return.

What is the impact of inflation here? To answer, suppose pizzas cost $5 apiece at the beginning of the year. With $100, we can buy 20 pizzas. Because the inflation rate is 5 percent, pizzas will cost 5 percent more, or $5.25, at the end of the year. If we take the investment, how many pizzas can we buy at the end of the year? Measured in pizzas, what is the rate of return on this investment?

Current and historical Treasury yield information is available at www.bankofcanada.ca

Our $115.50 from the investment will buy us $115.50/5.25 = 22 pizzas. This is up from 20 pizzas, so our pizza rate of return is 10 percent. What this illustrates is that even though the nominal return on our investment is 15.5 percent, our buying power goes up by only 10 percent because of inflation. Put another way, we are really only 10 percent richer. In this case, we say that the real return is 10 percent.

Alternatively, we can say that with 5 percent inflation, each of the $115.50 nominal dollars we get is worth 5 percent less in real terms, so the real dollar value of our investment in a year is:

$$\$115.50/1.05 = \$110$$

What we have done is to *deflate* the $115.50 by 5 percent. Because we give up $100 in current buying power to get the equivalent of $110, our real return is again 10 percent. Because we have removed the effect of future inflation here, this $110 is said to be measured in current dollars.

The difference between nominal and real rates is important and bears repeating:

> The nominal rate on an investment is the percentage change in the number of dollars you have.
> The real rate on an investment is the percentage change in how much you can buy with your dollars, in other words, the percentage change in your buying power.

The Fisher Effect

Fisher effect
The relationship between nominal returns, real returns, and inflation.

Our discussion of real and nominal returns illustrates a relationship often called the **Fisher effect** (after the great economist Irving Fisher). Because investors are ultimately concerned with what they can buy with their money, they require compensation for inflation.[9] Let R stand for the nominal rate and r stand for the real rate. The Fisher effect tells us that the relationship between nominal rates, real rates, and inflation can be written as:

$$1 + R = (1 + r) \times (1 + h) \quad [7.2]$$

where h is the inflation rate.

In the preceding example, the nominal rate was 15.50 percent and the inflation rate was 5 percent. What was the real rate? We can determine it by plugging in these numbers:

$$1 + .1550 = (1 + r) \times (1 + .05)$$
$$1 + r = 1.1550/1.05 = 1.10$$
$$r = 10\%$$

This real rate is the same as we had before. If we take another look at the Fisher effect, we can rearrange things a little as follows:

$$1 + R = (1 + r) \times (1 + h) \quad [7.3]$$
$$R = r + h + r \times h$$

What this tells us is that the nominal rate has three components. First, there is the real rate on the investment, r. Next, there is the compensation for the decrease in the value of the money originally invested because of inflation, h. The third component represents compensation for the fact that the dollars earned on the investment are also worth less because of the inflation.

This third component is usually small, so it is often dropped. The nominal rate is then approximately equal to the real rate plus the inflation rate:

$$R \approx r + h \quad [7.4]$$

EXAMPLE 7.4: The Fisher Effect

If investors require a 10 percent real rate of return, and the inflation rate is 8 percent, what must be the approximate nominal rate? The exact nominal rate?

First of all, the nominal rate is approximately equal to the sum of the real rate and the inflation rate: 10% + 8% = 18%. From the Fisher effect, we have:

$$1 + R = (1 + r) \times (1 + h)$$
$$= 1.10 \times 1.08$$
$$= 1.1880$$

Therefore, the nominal rate will actually be closer to 19 percent.

It is important to note that financial rates, such as interest rates, discount rates, and rates of return, are almost always quoted in nominal terms.

CONCEPT QUESTIONS

1. What is the difference between a nominal and a real return? Which is more important to a typical investor?
2. What is the Fisher effect?

9 Here we are referring to the *expected* inflation rate, rather than the actual inflation rate. Buyers and sellers of investments must use their best estimate of future inflation rates at the time of a transaction. Actual rates of inflation are not known until a considerable period after the purchase or sale, when all the cash flows from the investment instrument have taken place.

7.7 DETERMINANTS OF BOND YIELDS

We are now in a position to discuss the determinants of a bond's yield. As we will see, the yield on any particular bond is a reflection of a variety of factors, some common to all bonds and some specific to the issue under consideration.

The Term Structure of Interest Rates

At any point in time, short-term and long-term interest rates will generally be different. Sometimes short-term rates are higher, sometimes lower. Through time, the difference between short- and long-term rates has ranged from essentially zero to up to several percentage points, both positive and negative.

term structure of interest rates
The relationship between nominal interest rates on default-free, pure discount securities and time to maturity; that is, the pure time value of money.

The relationship between short- and long-term interest rates is known as the **term structure of interest rates.** To be a little more precise, the term structure of interest rates tells us what *nominal* interest rates are on *default-free, pure discount* bonds of all maturities. These rates are, in essence, "pure" interest rates because they involve no risk of default and a single, lump-sum future payment. In other words, the term structure tells us the pure time value of money for different lengths of time.

When long-term rates are higher than short-term rates, we say that the term structure is upward sloping, and, when short-term rates are higher, we say it is downward sloping. The term structure can also be "humped." When this occurs, it is usually because rates increase at first, but then begin to decline as we look at longer- and longer-term rates. The most common shape of the term structure, particularly in modern times, is upward sloping, but the degree of steepness has varied quite a bit.

What determines the shape of the term structure? There are three basic components. The first two are the ones we discussed in our previous section, the real rate of interest and the rate of inflation. The real rate of interest is the compensation investors demand for forgoing the use of their money. You can think of it as the pure time value of money after adjusting for the effects of inflation.

The real rate of interest is the basic component underlying every interest rate, regardless of the time to maturity. When the real rate is high, all interest rates will tend to be higher, and vice versa. Thus, the real rate doesn't really determine the shape of the term structure; instead, it mostly influences the overall level of interest rates.

In contrast, the prospect of future inflation very strongly influences the shape of the term structure. Investors thinking about loaning money for various lengths of time recognize that future inflation erodes the value of the dollars that will be returned. As a result, investors demand compensation for this loss in the form of higher nominal rates. This extra compensation is called the **inflation premium.**

inflation premium
The portion of a nominal interest rate that represents compensation for expected future inflation.

If investors believe that the rate of inflation will be higher in future, then long-term nominal interest rates will tend to be higher than short-term rates. Thus, an upward-sloping term structure may be a reflection of anticipated increases in inflation. Similarly, a downward-sloping term structure probably reflects the belief that inflation will be falling in the future.

The third, and last, component of the term structure has to do with interest rate risk. As we discussed earlier in the chapter, longer-term bonds have much greater risk of loss resulting from changes in interest rates than do shorter-term bonds. Investors recognize this risk, and they demand extra compensation in the form of higher rates for bearing it. This extra compensation is called the **interest rate risk premium.** The longer is the term to maturity, the greater is the interest rate risk, so the interest rate risk premium increases with maturity. However, as we discussed earlier, interest rate risk increases at a decreasing rate, so the interest rate risk premium does as well.[10]

interest rate risk premium
The compensation investors demand for bearing interest rate risk.

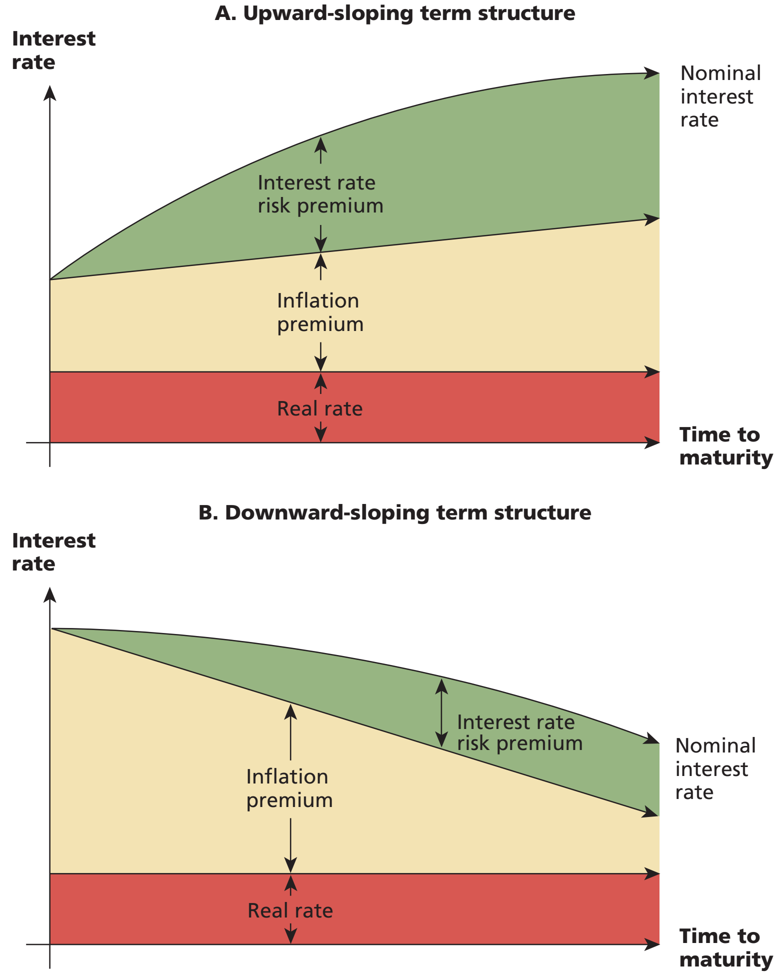
Putting the pieces together, we see that the term structure reflects the combined effect of the real rate of interest, the inflation premium, and the interest rate risk premium. Figure 7.4 shows how these can interact to produce an upward-sloping term structure (in the top part of Figure 7.4) or a downward-sloping term structure (in the bottom part).

In the top part of Figure 7.4, notice how the rate of inflation is expected to rise gradually. At the same time, the interest rate risk premium increases at a decreasing rate, so the combined

10 In days of old, the interest rate risk premium was called a "liquidity" premium. Today, the term *liquidity premium* has an altogether different meaning, which we explore in our next section. Also, the interest rate risk premium is sometimes called a maturity risk premium. Our terminology is consistent with the modern view of the term structure.

Figure 7.4

The term structure of interest rates



effect is to produce a pronounced upward-sloping term structure. In the bottom part of Figure 7.4, the rate of inflation is expected to fall in the future, and the expected decline is enough to offset the interest rate risk premium and produce a downward-sloping term structure. Notice that if the rate of inflation was expected to decline by only a small amount, we could still get an upward-sloping term structure because of the interest rate risk premium.

We assumed in drawing Figure 7.4 that the real rate would remain the same. Actually, expected future real rates could be larger or smaller than the current real rate. Also, for simplicity, we used straight lines to show expected future inflation rates as rising or declining, but they do not necessarily have to look like this. They could, for example, rise and then fall, leading to a humped yield curve.

Bond Yields and the Yield Curve: Putting It All Together

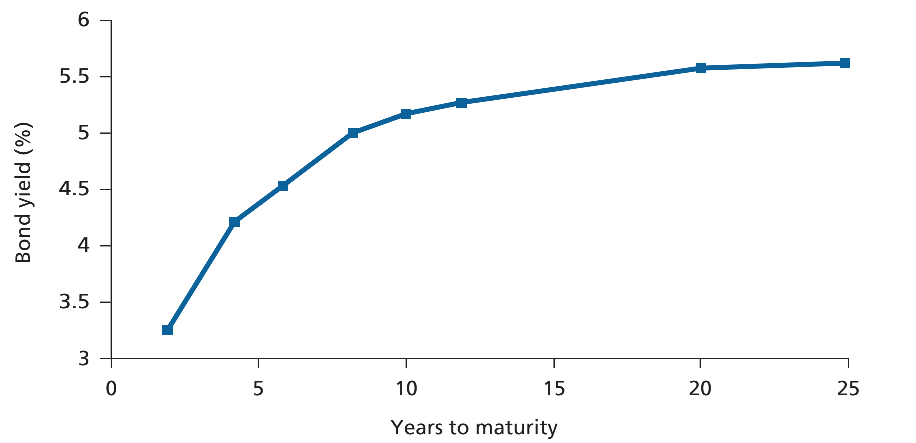
Going back to Figure 7.3, recall that we saw that the yields on Government of Canada bonds of different maturities are not the same. Each day, we can plot the Canada bond prices and yields shown in Figure 7.3, relative to maturity. This plot is called the **Canada yield curve** (or just the yield curve). Figure 7.5 shows the yield curve drawn from the yields in Figure 7.3.

Canada yield curve
A plot of the yields on Government of Canada notes and bonds relative to maturity.

As you probably now suspect, the shape of the yield curve is a reflection of the term structure of interest rates. In fact, the Canada yield curve and the term structure of interest rates are almost the same thing. The only difference is that the term structure is based on pure discount bonds, whereas the yield

Figure 7.5

Government of Canada yield curve



Source: *National Post,* November 29, 2002, p. D12.

curve is based on coupon bond yields. As a result, Canada yields depend on the three components that underlie the term structure—the real rate, expected future inflation, and the interest rate risk premium.

Canada bonds have three important features that we need to remind you of: they are default-free, they are taxable, and they are highly liquid. This is not true of bonds in general, so we need to examine what additional factors come into play when we look at bonds issued by corporations or municipalities.

default risk premium
The portion of a nominal interest rate or bond yield that represents compensation for the possibility of default.

The first thing to consider is credit risk, that is, the possibility of default. Investors recognize that issuers other than the Government of Canada may or may not make all the promised payments on a bond, so they demand a higher yield as compensation for this risk. This extra compensation is called the **default risk premium.** Earlier in the chapter, we saw how bonds were rated based on their credit risk. What you will find if you start looking at bonds of different ratings is that lower-rated bonds have higher yields.

An important thing to recognize about a bond's yield is that it is calculated assuming that all the promised payments will be made. As a result, it is really a promised yield, and it may or may not be what you will earn. In particular, if the issuer defaults, your actual yield will be lower, probably much lower. This fact is particularly important when it comes to junk bonds. Thanks to a clever bit of marketing, such bonds are now commonly called high-yield bonds, which has a much nicer ring to it; but now you recognize that these are really high–*promised* yield bonds.

liquidity premium
The portion of a nominal interest rate or bond yield that represents compensation for lack of liquidity.

Finally, bonds have varying degrees of liquidity. As we discussed earlier, there is an enormous number of bond issues, most of which do not trade on a regular basis. As a result, if you wanted to sell quickly, you would probably not get as good a price as you could otherwise. Investors prefer liquid assets to illiquid ones, so they demand a **liquidity premium** on top of all the other premiums we have discussed. As a result, all else being the same, less liquid bonds will have higher yields than more liquid bonds.

Conclusion

If we combine all of the things we have discussed regarding bond yields, we find that bond yields represent the combined effect of no fewer than six things. The first is the real rate of interest. On top of the real rate are five premiums representing compensation for (1) expected future inflation, (2) interest rate risk, (3) default risk, (4) taxability, and (5) lack of liquidity. As a result, determining the appropriate yield on a bond requires careful analysis of each of these effects.

CONCEPT QUESTIONS

1. What is the term structure of interest rates? What determines its shape?
2. What is the Canada yield curve?
3. What are the six components that make up a bond's yield?

7.8 SUMMARY AND CONCLUSIONS

This chapter has explored bonds, bond yields, and interest rates. We saw that:

1. Determining bond prices and yields is an application of basic discounted cash flow principles.
2. Bond values move in the direction opposite that of interest rates, leading to potential gains or losses for bond investors.
3. Bonds have a variety of features spelled out in a document called the indenture.
4. Bonds are rated based on their default risk. Some bonds, such as Treasury bonds, have no risk of default, whereas so-called junk bonds have substantial default risk.
5. A wide variety of bonds exist, many of which contain exotic or unusual features.
6. Almost all bond trading is OTC, with little or no market transparency. As a result, bond price and volume information can be difficult to find.
7. Bond yields reflect the effect of the real rate and premiums that investors demand as compensation for inflation and interest rate risk.

In closing, we note that bonds are a vital source of financing to governments and corporations of all types. Bond prices and yields are a rich subject, and our one chapter, necessarily, touches on only the most important concepts and ideas. There is a great deal more we could say, but, instead, we will move on to stocks in our next chapter.

Key Terms

bearer form (page 182)
bond refunding (App. 7B page 203)
call premium (page 183)
call protected (page 183)
call provision (page 183)
Canada plus call (page 183)
Canada yield curve (page 194)
coupon rate (page 173)
coupons (page 172)
debenture (page 182)
default risk premium (page 195)
deferred call (page 183)
face value or par value (page 172)
Fisher effect (page 192)
indenture (page 181)
inflation premium (page 193)
interest rate risk premium (page 193)
liquidity premium (page 195)
maturity date (page 173)
nominal rates (page 191)
note (page 182)
protective covenant (page 183)
real rates (page 191)
registered form (page 182)
retractable bond (page 188)
sinking fund (page 183)
stripped bond/zero-coupon bond (page 187)
term structure of interest rates (page 193)
yield to maturity (YTM) (page 173)

Chapter Review Problems and Self-Test

7.1 Bond Values A Microgates Industries bond has a 10 percent coupon rate and a $1,000 face value. Interest is paid semiannually, and the bond has 20 years to maturity. If investors require a 12 percent yield, what is the bond's value? What is the effective annual yield on the bond?

7.2 Bond Yields A Macrohard Corp. bond carries an 8 percent coupon, paid semiannually. The par value is $1,000 and the bond matures in six years. If the bond currently sells for $911.37, what is its yield to maturity? What is the effective annual yield?

Answers to Self-Test Problems

7.1 Because the bond has a 10 percent coupon yield and investors require a 12 percent return, we know that the bond must sell at a discount. Notice that, because the bond pays interest semiannually, the coupons amount to $100/2 = $50 every six months. The required yield is 12%/2 = 6% every six months. Finally, the bond matures in 20 years, so there are a total of 40 six-month periods.

The bond's value is thus equal to the present value of $50 every six months for the next 40 six-month periods plus the present value of the $1,000 face amount:

$$\begin{aligned}\text{Bond value} &= \$50 \times (1 - 1/1.06)^{40})/.06 + 1{,}000/1.06^{40}\\ &= \$50 \times 15.04630 + 1{,}000/10.2857\\ &= \$849.54\end{aligned}$$

Notice that we discounted the $1,000 back 40 periods at 6 percent per period, rather than 20 years at 12 percent. The reason is that the effective annual yield on the bond is $1.06^2 - 1 = 12.36\%$, not 12 percent. We thus could have used 12.36 percent per year for 20 years when we calculated the present value of the $1,000 face amount, and the answer would have been the same.

7.2 The present value of the bond's cash flows is its current price, $911.37. The coupon is $40 every six months for 12 periods. The face value is $1,000. So the bond's yield is the unknown discount rate in the following:

$$\$911.37 = \$40 \times [1 - 1/(1 + r)^{12}]/r + 1{,}000/(1 + r)^{12}$$

The bond sells at a discount. Because the coupon rate is 8 percent, the yield must be something in excess of that.

If we were to solve this by trial and error, we might try 12 percent (or 6 percent per six months):

$$\begin{aligned}\text{Bond value} &= \$40 \times (1 - 1/1.06^{12})/.06 + 1{,}000/1.06^{12}\\ &= \$832.32\end{aligned}$$

This is less than the actual value, so our discount rate is too high. We now know that the yield is somewhere between 8 and 12 percent. With further trial and error (or a little machine assistance), the yield works out to be 10 percent, or 5 percent every six months.

By convention, the bond's yield to maturity would be quoted as 2 × 5% = 10%. The effective yield is thus $1.05^2 - 1 = 10.25\%$.

Concepts Review and Critical Thinking Questions

1. Is it true that a Government of Canada security is risk-free?
2. Which has greater interest rate risk, a 30-year Canada bond or a 30-year BB corporate bond?
3. With regard to bid and ask prices on a Canada bond, is it possible for the bid price to be higher? Why or why not?
4. Canada bid and ask quotes are sometimes given in terms of yields, so there would be a bid yield and an ask yield. Which do you think would be larger? Explain.
5. A company is contemplating a long-term bond issue. It is debating whether or not to include a call provision. What are the benefits to the company from including a call provision? What are the costs? How do these answers change for a put provision?
6. How does a bond issuer decide on the appropriate coupon rate to set on its bonds? Explain the difference between the coupon rate and the required return on a bond.
7. Are there any circumstances under which an investor might be more concerned about the nominal return on an investment than the real return?
8. Companies pay rating agencies such as the Dominion Bond Rating Service to rate their bonds, and the costs can be substantial. However, companies are not required to have their bonds rated in the first place; doing so is strictly voluntary. Why do you think they do it?
9. Canada bonds are not rated. Why? Often, junk bonds are not rated. Why?
10. What is the difference between the term structure of interest rates and the yield curve?

Questions and Problems

Basic (Questions 1–14)

1. **Interpreting Bond Yields** Is the yield to maturity on a bond the same thing as the required return? Is YTM the same thing as the coupon rate? Suppose today a 10 percent coupon bond sells at par. Two years from now, the required return on the same bond is 8 percent. What is the coupon rate on the bond now? The YTM?

Basic (continued)

2. **Interpreting Bond Yields** Suppose you buy a 7 percent coupon, 20-year bond today when it's first issued. If interest rates suddenly rise to 15 percent, what happens to the value of your bond? Why?
3. **Bond Prices** WMS, Inc., has 7 percent coupon bonds on the market that have 10 years left to maturity. The bonds make annual payments. If the YTM on these bonds is 9 percent, what is the current bond price?
4. **Bond Yields** Finley Co. has 10 percent coupon bonds on the market with nine years left to maturity. The bonds make annual payments. If the bond currently sells for $1,075.25, what is its YTM?
5. **Coupon Rates** Mustaine Enterprises has bonds on the market making annual payments, with 13 years to maturity, and selling for $850. At this price, the bonds yield 7.4 percent. What must the coupon rate be on Mustaine's bonds?
6. **Bond Prices** Mullineaux Co. issued 11-year bonds one year ago at a coupon rate of 8.6 percent. The bonds make semiannual payments. If the YTM on these bonds is 7.5 percent, what is the current bond price?
7. **Bond Yields** Clapper Corp. issued 12-year bonds two years ago at a coupon rate of 7.8 percent. The bonds make semiannual payments. If these bonds currently sell for 108 percent of par value, what is the YTM?
8. **Coupon Rates** Barely Heroes Corporation has bonds on the market with 14.5 years to maturity, a YTM of 9 percent, and a current price of $850. The bonds make semiannual payments. What must the coupon rate be on Barely Heroes' bonds?
9. **Calculating Real Rates of Return** If Treasury bills are currently paying 8 percent and the inflation rate is 6 percent, what is the approximate real rate of interest? The exact real rate?
10. **Inflation and Nominal Returns** Suppose the real rate is 3.5 percent and the inflation rate is 3 percent. What rate would you expect to see on a Treasury bill?
11. **Nominal and Real Returns** An investment offers a 16 percent total return over the coming year. Alan Wingspan thinks the total real return on this investment will be only 10 percent. What does Alan believe the inflation rate will be over the next year?
12. **Nominal versus Real Returns** Say you own an asset that had a total return last year of 13 percent. If the inflation rate last year was 4 percent, what was your real return?
13. **Bond Pricing** This problem refers to the bond quotes in Figure 7.3. Calculate the price of the Canada 7 Dec01/06 to prove that it is 110.23 as shown. Assume that today is November 29, 2002.
14. **Bond Value** At the time of the last referendum, Quebec provincial bonds carried a higher yield than comparable Ontario bonds because of investors' uncertainty about the political future of Quebec. Suppose you were an investment manager who thought the market was overplaying these fears. In particular, suppose you thought that yields on Quebec bonds would fall by 50 basis points. Which bonds would you buy or sell? Explain in words.

Intermediate (Questions 15–25)

15. **Bond Price Movements** Bond X is a premium bond making annual payments. The bond pays a 9 percent coupon, has a YTM of 7 percent, and has 13 years to maturity. Bond Y is a discount bond making annual payments. This bond pays a 7 percent coupon, has a YTM of 9 percent, and also has 13 years to maturity. If interest rates remain unchanged, what do you expect the price of these bonds to be one year from now? In three years? In eight years? In 12 years? In 13 years? What's going on here? Illustrate your answers by graphing bond prices versus time to maturity.
16. **Interest Rate Risk** Both Bond Bob and Bond Tom have 8 percent coupons, make semiannual payments, and are priced at par value. Bond Bob has 2 years to maturity, whereas Bond Tom has 15 years to maturity. If interest rates suddenly rise by 2 percent, what is the percentage change in the price of Bond Bob? Of Bond Tom? If rates were to suddenly fall by 2 percent instead, what would the percentage change in the price of Bond Bob be then? Of Bond Tom? Illustrate your answers by graphing bond prices versus YTM. What does this problem tell you about the interest rate risk of longer-term bonds?
17. **Interest Rate Risk** Bond J is a 5 percent coupon bond. Bond K is an 11 percent coupon bond. Both bonds have 8 years to maturity, make semiannual payments, and have a YTM of 8 percent. If interest rates suddenly rise by 2 percent, what is the percentage price change of these bonds? What if rates suddenly fall by 2 percent instead? What does this problem tell you about the interest rate risk of lower-coupon bonds?
18. **Bond Yields** Lifehouse Software has 10 percent coupon bonds on the market with 7 years to maturity. The bonds make semiannual payments and currently sell for 104 percent of par. What is the current yield on Lifehouse's bonds? The YTM? The effective annual yield?
19. **Bond Yields** BDJ Co. wants to issue new 10-year bonds for some much-needed expansion projects. The company currently has 8 percent coupon bonds on the market that sell for $1,095, make semiannual payments, and mature in 10 years. What coupon rate should the company set on its new bonds if it wants them to sell at par?
20. **Finding the Bond Maturity** Massey Co. has 12 percent coupon bonds making annual payments with a YTM of 9 percent. The current yield on these bonds is 9.80 percent. How many years do these bonds have left until they mature?

Intermediate (continued)

21. Using Bond Quotes Suppose the following bond quote for IOU Corporation appears on the financial page of today's newspaper. If this bond has a face value of $1,000, what closing price appeared in yesterday's newspaper?

Bonds	Cur Yld	Vol	Close	Net Chg
IOU 7.875	9.4	10	??	−1/2

22. Bond Prices versus Yields

a. What is the relationship between the price of a bond and its YTM?

b. Explain why some bonds sell at a premium over par value while other bonds sell at a discount. What do you know about the relationship between the coupon rate and the YTM for premium bonds? What about for discount bonds? For bonds selling at par value?

c. What is the relationship between the coupon rate and YTM for premium bonds? For discount bonds? For bonds selling at par value?

23. Interest on Zeroes HSD Corporation needs to raise funds to finance a plant expansion, and it has decided to issue 20-year zero coupon bonds to raise the money. The required return on the bonds will be 9 percent.

a. What will these bonds sell for at issuance?

b. What interest deduction can HSD Corporation take on these bonds in the first year? In the last year?

c. Repeat part (b) using the straight-line method for the interest deduction.

d. Based on your answers in (b) and (c), which interest deduction method would HSD Corporation prefer? Why?

24. Zero Coupon Bonds Suppose your company needs to raise $10 million and you want to issue 30-year bonds for this purpose. Assume the required return on your bond issue will be 9 percent, and you're evaluating two issue alternatives: a 9 percent annual coupon bond and a zero coupon bond. Your company's tax rate is 35 percent.

a. How many of the coupon bonds would you need to issue to raise the $10 million? How many of the zeroes would you need to issue?

b. In 30 years, what will your company's repayment be if you issue the coupon bonds? What if you issue the zeroes?

c. Based on your answers in (a) and (b), why would you ever want to issue the zeroes? To answer, calculate the firm's aftertax cash outflows for the first year under the two different scenarios.

25. Finding the Maturity You've just found a 10 percent coupon bond on the market that sells for par value. What is the maturity on this bond?

Challenge (Questions 26–28)

26. Components of Bond Returns Bond P is a premium bond with a 10 percent coupon. Bond D is a 6 percent coupon bond currently selling at a discount. Both bonds make annual payments, have a YTM of 8 percent, and have eight years to maturity. What is the current yield for Bond P? For Bond D? If interest rates remain unchanged, what is the expected capital gains yield over the next year for Bond P? For Bond D? Explain your answers and the interrelationship among the various types of yields.

27. Holding Period Yield The YTM on a bond is the interest rate you earn on your investment if interest rates don't change. If you actually sell the bond before it matures, your realized return is known as the holding period yield (HPY).

a. Suppose that today you buy a 9 percent coupon bond making annual payments for $1,150. The bond has 10 years to maturity. What rate of return do you expect to earn on your investment?

b. Two years from now, the YTM on your bond has declined by 1 percent, and you decide to sell. What price will your bond sell for? What is the HPY on your investment? Compare this yield to the YTM when you first bought the bond. Why are they different?

28. Valuing Bonds The Moulon Rouge Corporation has two different bonds currently outstanding. Bond M has a face value of $20,000 and matures in 20 years. The bond makes no payments for the first six years, then pays $1,000 every six months over the subsequent eight years, and finally pays $1,750 every six months over the last six years. Bond N also has a face value of $20,000 and a maturity of 20 years; it makes no coupon payments over the life of the bond. If the required return on both these bonds is 12 percent compounded semiannually, what is the current price of Bond M? Of Bond N?

Chapter 7 Mini Case

With current market conditions, you have decided that you want a higher weight of bonds in your investment portfolio. You have $15,000 to invest, and have narrowed your choices to the following three options:

Option 1

A junk bond is available that sells for $90 (for each $100 in face value). The bond makes semiannual coupon payments of 6 percent.

Option 2

A blue-chip corporate bond is currently selling for $93 (for each $100 in face value), and pays semiannual coupons of 3.5 percent.

Option 3

A zero-coupon bond issued by the Province of Saskatchewan is currently available for a price of $85 (for each $100 in face value).

All bonds mature in five years, and you have decided that you will purchase only one option and hold that bond to maturity.

a) What will your annual return be from each investment option?

b) How much would you be willing to pay for each bond if you demanded a 7 percent annual return? A 10 percent return?

c) If market rates remain unchanged, what will the price of each bond be in 18 months? (Assume you are buying on Jan.1.)

d) If required market returns are 1.5 percent higher in two years and you decide to sell at that time, what is your total return? Your investment yield?

e) Which of the bonds would you pick and why?

S&P Problem

1. **Bond Rating** Look up Biomira Inc. (BIOM), Nortel Networks Corp. (NT), Alcan Inc. (AL), and Placer Dome Inc. (PDG). For each company, follow the "Financial Highlights" link and find the bond rating. Which companies have an investment grade rating? Which companies are rated below investment grade? Are any unrated? When you find the credit rating for one of the companies, click on the "S&P Issuer Credit Rating" link. What are the three considerations listed that Standard & Poor's uses to issue a credit rating?

Internet Application Questions

1. The bond spread refers to the difference in yields between two bonds. Usually, the lower yielding bond is a risk-free bond such as a Government of Canada bond with equivalent maturity. Go to the following website and explain why bond spreads narrow as you get closer to maturity. What does the size of the spread tell you?
   www.finpipe.com/spread.htm
2. The Bank of Canada maintains a site containing historical bond yields. Pick a short-term bond, and a real return bond, and compare their yields. What is your expectation of inflation for the coming year? www.bankofcanada.ca/en/bond-look.htm
3. Barclays Global Investors has recently started two new exchange traded bond funds, iG5 and iG10. Explain the advantage of investing in exchange traded bond funds relative to buying the bonds outright. www.barclaysglobal.com
4. Go to the website of the Dominion Bond Rating Service at www.dbrs.com. Use Quick Search and Ticker Lookup to find Manufacturers Life Insurance Company and look up its rating. Do the same for Loblaw and Rogers Communication Inc. Which companies are investment grade? Are any Junk? Now click on Rating and Methodologies? Which are the key factors in determining ratings?

Suggested Readings

The best place to look for additional information about valuing stocks and bonds is in an investments textbook. Good ones are

Bodie, Z., A. Kane, A. Marcus, S. Perrakis, and P. Ryan. *Investments,* 4th Canadian ed. Whitby, Ontario: McGraw-Hill Ryerson, 2003.

Sharpe, W. F., G. J. Alexander, J. V. Bailey, D. J. Fowler, and D. Domian. *Investments,* 3rd Canadian ed. Scarborough, Ont.: Prentice-Hall Canada, 1999.

For more on duration applications see Appendix 7A and the following articles:

Fooladi, I., and G. S. Roberts. "How Effective Are Duration-Based Bond Strategies in Canada?" *Canadian Investment Review,* Spring 1989, pp. 57–61.

Bierwag, G. O., I. J. Fooladi, and G. S. Roberts. "Risk Management with Duration: Potential and Limitations." *Canada Journal of Administrative Sciences,* 2000.

7A ON DURATION

Our discussion of interest rate risk and applications explains how bond managers can select bonds to enhance price volatility when interest rates are falling. In this case, we recommended buying long-term, low-coupon bonds. When they apply this advice, Canadian bond managers use *duration*—a measure of a bond's effective maturity incorporating both time to maturity and coupon rate. This Appendix explains how duration is calculated and how it is used by bond managers.

Consider a portfolio consisting of two pure discount (zero coupon) bonds. The first bond matures in one year and the second after five years. As pure discount bonds, each provides a cash flow of \$100 at maturity and nothing before maturity. Assuming the interest rate is 10 percent across all maturities, the bond prices are:

$$\text{Value of the one-year discount bond: } \frac{\$100}{1.10} = \$90.91$$

$$\text{Value of the five-year discount bond: } \frac{\$100}{(1.10)^5} = \$62.09$$

Which of these bonds would produce the greater percentage capital gain if rates drop to 8 percent across all maturities? From the text discussion, we know that price volatility increases with maturity and decreases with the coupon rate. Both bonds have the same coupon rate (namely zero), so the five-year bond should produce the larger percentage gain.

To prove this, we calculate the new prices and percentage changes. The one-year bond is now priced at \$92.59 and has increased in price by 1.85%.[11] The five-year bond is now priced at \$68.06 for a price rise of 9.61 percent. You should be able to prove that the effect works the other way. If interest rates rise to 12 percent across maturities, the five-year bond will have the greater percentage loss.

If all bonds were pure discount bonds, time to maturity would be a precise measure of price volatility. In reality, most bonds bear coupon payments. Duration provides a measure of effective maturity that incorporates the impact of differing coupon rates.

Duration

We begin by noticing that any coupon bond is actually a combination of pure discount bonds. For example, a five-year, 10 percent coupon bond, with a face value of \$100, is made up of five pure discount bonds:

11 The percentage price increase is: (\$92.59 – \$90.91)/\$90.91 = 1.85%.

1. A pure discount bond paying $10 at the end of Year 1.
2. A pure discount bond paying $10 at the end of Year 2.
3. A pure discount bond paying $10 at the end of Year 3.
4. A pure discount bond paying $10 at the end of Year 4.
5. A pure discount bond paying $110 at the end of Year 5.

Because the price volatility of a pure discount bond is determined only by its maturity, we would like to determine the average maturity of the five pure discount bonds that make up a five-year coupon bond. This leads us to the concept of duration.

We calculate average maturity in three steps for the 10 percent coupon bond:

1. Calculate present value of each payment using the bond's yield to maturity. We do this as

Year	Payment	Present Value of Payment by Discounting at 10%
1	$ 10	$ 9.091
2	10	8.264
3	10	7.513
4	10	6.830
5	110	68.302
Total		$100.000

2. Express the present value of each payment in relative terms. We calculate the relative value of a single payment as the ratio of the present value of the payment to the value of the bond. The value of the bond is $100. We have

Year	Payment	Present Value of Payment	Relative value = Present Value of Payment ÷ Value of Bond
1	$ 10	$ 9.091	$9.091/$100 = 0.09091
2	10	8.264	0.08264
3	10	7.513	0.07513
4	10	6.830	0.0683
5	110	68.302	0.68302
Total		$100.000	1.00000

The bulk of the relative value, 68.302 percent, occurs at Date 5 because the principal is paid back at that time.

3. Weight the maturity of each payment by its relative value. We have

$$4.1699 \text{ years} = 1 \text{ year} \times 0.09091 + 2 \text{ years} \times 0.08264 + 3 \text{ years} \times 0.07513 + 4 \text{ years} \times 0.06830 + 5 \text{ years} \times 0.68302$$

There are many ways to calculate the average maturity of a bond. We have calculated it by weighting the maturity of each payment by the payment's present value. We find that the effective maturity of the bond is 4.1699 years. *Duration* is a commonly used word for effective maturity. Thus, the bond's duration is 4.1699 years. Note that duration is expressed in units of time.[12]

Because the five-year, 10 percent coupon bond has a duration of 4.1699 years, its percentage price fluctuations should be the same as those of a zero coupon bond with a duration of

12 Also note that we discounted each payment by the interest rate of 10 percent. This was done because we wanted to calculate the duration of the bond before a change in the interest rate occurred. After a change in the rate to say 8 or 12 percent, all three of our steps would need to reflect the new interest rate. In other words, the duration of a bond is a function of the current interest rate.

4.1699 years.[13] It turns out that a five-year, 1 percent coupon bond has a duration of 4.8742 years. Because the 1 percent coupon bond has a higher duration than the 10 percent bond, the 1 percent coupon bond should be subject to greater price fluctuations. This is exactly what we expected.

Why does the 1 percent bond have a greater duration than the 10 percent bond, even though they both have the same five-year maturity? As mentioned earlier, duration is an average of the maturity of the bond's cash flows, weighted by the present value of each cash flow. The 1 percent coupon bond receives only $1 in each of the first four years. Thus, the weights applied to Years 1 through 4 in the duration formula will be low. Conversely, the 10 percent coupon bond receives $10 in each of the first four years. The weights applied to Years 1 through 4 in the duration formula will be higher.

In general, the percentage price changes of a bond with high duration are greater than the percentage price changes for a bond with low duration. This property is useful to investment managers who seek superior performance. These managers extend portfolio duration when rates are expected to fall and reduce duration in the face of rising rates.

Because forecasting rates consistently is almost impossible, other managers hedge their returns by setting the duration of their assets equal to the duration of liabilities. In this way, market values on both sides of the balance sheet adjust in the same direction keeping the market value of net worth constant. Duration hedging is often called portfolio immunization.

Current research on Government of Canada bond returns shows that duration is a practical way of measuring bond price volatility and an effective tool for hedging interest rate risk.

Appendix Questions and Problems

A.1 Why do portfolio managers use duration instead of term to maturity as a measure of a bond's price volatility?

A.2 Calculate the duration of a seven-year Canada bond with a 9 percent coupon and a yield of 6 percent.

A.3 You are managing a bond portfolio following a policy of interest-rate anticipation. You think that rates have bottomed and are likely to rise. The average duration of your portfolio is 3.5 years. Which bonds are more attractive for new purchases, those with a 10-year duration or three-year duration? Explain.

7B CALLABLE BONDS AND BOND REFUNDING

bond refunding The process of replacing all or part of an issue of outstanding bonds.

The process of replacing all or part of an issue of outstanding bonds is called **bond refunding.**[14] As we have discussed, most corporate debt is callable. Typically, the first step in a bond refunding is to take advantage of this feature to call the entire issue of bonds at the call price.

Why would a firm want to refund a bond issue? One reason is obvious. Suppose a firm issues long-term debt with, say, a 12 percent coupon. Sometime after the issue, interest rates decline, and the firm finds that it could pay an 8 percent coupon and raise the same amount of money. Under such circumstances, the firm may wish to refund the debt. Notice that, in this case, refunding a bond issue is just a way of refinancing a higher-interest loan with a lower-interest one.

In the following discussion, we take a brief look at several issues concerning bond refunding and the call feature. First, what is the cost to the firm of a call provision? Second, what is the value

13 Actually, the relationship only exactly holds true in the case of a one-time shift in the flat yield curve, where the change in the spot rate is identical for all different maturities. But duration research finds that the error is small.

14 Our discussion focuses on refunding bonds. The analysis also applies to refunding preferred stock.

of a call provision? Third, given that the firm has issued callable bonds, when should they be refunded?[15]

The Call Provision

Common sense tells us that call provisions have value. First, almost all publicly issued bonds have such a feature. Second, a call clearly works to the advantage of the issuer. If interest rates fall and bond prices go up, the issuer has an option to buy back the bond at a bargain price.

On the other hand, all other things being equal, bondholders dislike call provisions. The reason is again obvious. If interest rates do fall, the bondholder's gain is limited because of the possibility that the bond will be called away. As a result, bondholders take the call provision into account when they buy, and they require compensation in the form of a higher coupon rate.

This is an important observation. A call provision is not free. Instead, the firm pays a higher coupon than otherwise. Whether paying this higher coupon rate is a good idea or not is the subject we turn to next.

Cost of the Call Provision

To illustrate the effect of a call feature on a bond's coupon, suppose Kraus Intercable Company intends to issue some perpetual bonds with a face value of $1,000. We stick with perpetuities because doing so greatly simplifies some of the analysis without changing the general results.

The current interest rate on such bonds is 10 percent; Kraus, therefore, sets the annual coupon at $100. Suppose there is an equal chance that by the end of the year interest rates will either:

1. Fall to 6⅔ percent. If so, the bond price will increase to $100/.067 = $1,500.
2. Increase to 20 percent. If so, the bond price will fall to $100/.20 = $500.

Notice that the bond could sell for either $500 or $1,500 with equal probability, so the expected price is $1,000.

We now consider the market price of the bond assuming it is not callable, P_{NC}. This is simply equal to the expected price of the bond next year plus the coupon, all discounted at the current 10 percent interest rate:

$$\begin{aligned} P_{NC} &= [\text{First-year coupon} + \text{Expected price at the end of year}]/1.10 \\ &= [\$100 + \$1{,}000]/1.10 \\ &= \$1{,}000 \end{aligned}$$

Thus, the bond sells at par.

Now suppose the Kraus Intercable Company decides to make the issue callable. To keep things as simple as possible, we assume the bonds must be called in one year or never. To call the bonds, Kraus has to pay the $1,000 face value plus a call premium of $150 for a total of $1,150. If Kraus wants the callable bond to sell for par, what coupon, C, must be offered?

To determine the coupon, we need to calculate what the possible prices are in one year. If interest rates decline, the bond will be called, and the bondholder will get $1,150. If interest rates rise, the bond will not be called, and it will thus be worth $C/.20$. So the expected price in one year is $.50 \times (C/.20) + .50 \times (\$1{,}150)$. If the bond sells for par, the price, P_C, is $1,000 and we have that:

$$\begin{aligned} P_C = \$1{,}000 &= [\text{First-year coupon} + \text{Expected price at end of year}]/1.10 \\ &= [\$C + \{.50 \times (\$C/.20) + .50 \times (\$1{,}150)\}]/1.10 \end{aligned}$$

15 For a more in-depth discussion of the subjects discussed in this Appendix, see John Finnerty, Andrew J. Kalotay, and Francis X. Farrell, Jr., *The Financial Manager's Guide to Evaluating Bond Refunding Opportunities,* The Institutional Investor Series in Finance and Financial Management Association Survey and Synthesis Series (Cambridge, MA: Ballinger Publishing Company, 1988). Our discussion is based in part on Alan Kraus, "An Analysis of Call Provisions and the Corporate Refunding Decision," *Midland Corporate Finance Journal,* Spring 1983.

If we solve this for C, we find that the coupon has to be

$$C = \$525/3.5 = \$150$$

This is substantially higher than the $100 we had before and illustrates that the call provision is not free.

What is the cost of the call provision here? To answer, we can calculate what the bond would sell for if it were not callable and had a coupon of $150:

$$\begin{aligned} P_{NC} &= [\text{First-year coupon} + \text{Expected price at end of year}]/1.10 \\ &= [\$150 + \{.50 \times (\$150/.20) + .50 \times (\$150/.067)\}]/1.10 \\ &= \$1{,}500 \end{aligned}$$

What we see is that the call provision effectively costs $500 per bond in this simple case because Kraus could have raised $1,500 per bond instead of $1,000 if the bonds were not callable.

Value of the Call Provision

We have seen what Kraus has to pay to make this bond issue callable. We now need to see what the value is to Kraus from doing so. If the value is more than $500, the call provision has a positive NPV and should be included. Otherwise, Kraus should issue non-callable bonds.

If Kraus issues a callable bond and interest rates drop to 6⅔ percent in a year, then Kraus can replace the 15 percent bond with a non-callable perpetual issue that carries a coupon of 6⅔ percent. The interest saving in this case is $150 – 66.67 = $83.33 per year every year forever (since these are perpetuities). At an interest rate of 6⅔ percent, the present value of the interest savings is $83.33/.067 = $1,250.

To do the refunding, Kraus has to pay a $150 premium, so the net present value of the refunding operation in one year is $1,250 – 150 = $1,100 per bond. However, there is only a 50 percent chance that the interest rate will drop, so we expect to get .50 × $1,100 = $550 from refunding in one year. The current value of this amount is $550/1.1 = $500. So we conclude that the value of the call feature to Kraus is $500.

It is *not* a coincidence that the cost and the value of the call provision are identical. All this says is that the NPV of the call feature is zero; the bondholders demand a coupon that exactly compensates them for the possibility of a call.

The Refunding Issue

In our preceding example, we saw that Kraus gained $1,100 per bond from the refunding operation if the interest rate fell. We now need to decide when, in general, a firm should refund an outstanding bond issue. The answer to this question can get fairly complicated, so we stick with our simplified case for the first pass and then consider a more realistic one. In particular, we continue to assume that

1. The bonds in question are perpetuities.
2. There are no taxes.
3. There are no refunding costs other than the call premium and the refunding is instantaneous. There is no overlap period when both issues are outstanding.
4. The bonds must be called now or never.[16]

16 The last of these assumptions cannot be easily eliminated. The problem is that when we call a bond in, we forever destroy the option to call it in later. Conceivably, it might be better to wait and call later in hopes of even lower interest rates. This is the same issue that we discuss in Chapter 11 when we discuss options in capital budgeting, in particular, the option to wait.

When Should Firms Refund Callable Bonds?

The following notation is useful in analyzing the refunding issue:

c_o = coupon rate on the outstanding bonds
c_N = coupon rate on the new issue, equal to the current market rate
CP = call premium per bond

We assume that the face value is $1,000 per bond. If we replace the old issue, then we save $(c_o - c_N) \times 1{,}000$ in interest per bond every year forever.

The current interest rate is c_N, so the present value of the interest saving is $(c_o - c_N) \times \$1{,}000/c_N$. It costs CP to call the bond, so the NPV[17] per bond of the refunding operation can be written simply as:

$$\text{NPV} = (c_o - c_N)/c_N \times \$1{,}000 - CP \qquad \textbf{[7B.1]}$$

With our Kraus example, the bonds were originally issued with a 15 percent coupon. The going interest rate fell to 6⅔ percent, and the call premium was $150. The NPV of the refunding is:

$$\begin{aligned}\text{NPV} &= (c_o - c_N) \times \$1{,}000 - CP\\ &= (.15 - .067)/.067 \times \$1{,}000 - \$150\\ &= 1.25 \times \$1{,}000 - \$150\\ &= \$1{,}100 \text{ per bond}\end{aligned}$$

This is as we had before (ignoring a slight rounding error): the present value of the interest savings from calling the bond is $1,250. Subtract the call premium of $150, and you have the NPV of calling the bond of $1,100 per bond.

EXAMPLE 7B.1: Who Ya Gonna Call?

Toastdusters, Inc., has an outstanding perpetuity with a 10 percent coupon rate. This issue must be called now or never. If it is called, it will be replaced with an issue that has a coupon rate of 8 percent, equal to the current interest rate. The call premium is $200 per bond. Should refunding commence? What is the NPV of a refunding?

Assuming a $1,000 face value, the interest saving would be $100 – 80 = $20 per bond, per year, forever. The present value of this saving is $20/.08 = $250 per bond. Since the call premium is $200 per bond, refunding should commence: The NPV is $50 per bond.

EXAMPLE 7B.2: Spreadsheet-Based Refunding Framework

The Nipigon Lake Mining Company has a $20 million outstanding bond issue bearing a 16 percent coupon that it issued in 1986. The bonds mature in 2010 but are callable in 2001 for a 6 percent call premium. Nipigon Lake's investment banker has assured it that up to $30 million of new nine-year bonds maturing in 2010 can be sold carrying an 11 percent coupon. To eliminate timing problems with the two issues, the new bonds will be sold a month before the old bonds are to be called. Nipigon Lake would have to pay the coupons on both issues during this month but can defray some of the cost by investing the issue at 8.5 percent, the short-term interest rate. Flotation costs for the $20 million new issue would total $1,125,000 and Nipigon Lake's marginal tax rate is 40 percent. Construct a framework to determine whether it is in Nipigon Lake's best interest to call the previous issue.

In constructing a framework to analyze a refunding operation, there are three steps: cost of refunding, interest savings, and the NPV of the refunding operation. All work described here is illustrated in Table 7B.1.

17 NPV, or net present value, is the difference between an investment's market value and its cost (see Chapter 9 for more detail).

Table 7B.1 Bond refunding worksheet

A B C D E F G H I J K L M N

1						
2						
3						
4		**Amount**	**Amount**	**Time**	**6.6 Percent**	
5		**Beforetax**	**Aftertax**	**Period**	**PV Factor**	**PV**
6	**PV Cost of Refunding**					
7	Call premium		$1,200,000	0	1.0000	$1,200,000
8	Flotation costs on new issue		1,125,000	0	1.0000	1,125,000
9	Tax savings on new issue flotation costs		–90,000	1-5	4.1445	–373,005
10	Extra interest on old issue	$ 266,667	160,000	0	1.0000	160,000
11	Interest on short-term investment	–141,667	–85,000	0	1.0000	–85,000
12	Total aftertax investment					$2,026,995
13						
14	**Interest savings for the refunded issue: t = 1 – 9**					
15	Interest on old bond	3,200,000	1,920,000			
16	Interest on new bond	2,200,000	1,320,000			
17	Net interest savings	$1,000,000	$ 600,000	1-9	6.6276	$3,976,560
18						
19	**NPV for refunding operation**					
20	NPV = PV of interest savings – PV of cost refunding					$1,949,565
21						
22						

COST OF REFUNDING The first step in this framework consists of calculating the call premium, the flotation costs and the related tax savings, and any extra interest that must be paid or can be earned.

$$\text{Call premium} = 0.06 \times (\$20{,}000{,}000) = \$1{,}200{,}000$$

Note that a call premium is not a tax-deductible expense.

FLOTATION COSTS Although flotation costs are a one-time expense, for tax purposes they are amortized over the life of the issue, or five years, whichever is less. For Nipigon Lake, flotation costs amount to $1,125,000. This results in an annual expense for the first five years after the issue.

$$\$1{,}125{,}000/5 = \$225{,}000$$

Flotation costs produce an annual tax shield of $90,000.

$$\$225{,}000 \times (0.4) = \$90{,}000$$

The tax savings on the flotation costs are a five-year annuity and would be discounted at the after-tax cost of debt (11%(1 – .40) = 6.6%). This amounts to a savings of $373,005. Therefore, the total flotation costs of issuing debt are:

Flotation costs	$1,125,000
PV of tax savings	–373,005
Total aftertax cost	$ 751,995

ADDITIONAL INTEREST Extra interest paid on old issue:

$$\$20{,}000{,}000 \times (16\% \times 1/2) = \$266{,}667$$

Aftertax: $\$266{,}667 \times (1 - .40) = \$160{,}000$

By investing the proceeds of the new issue at short-term interest rates, some of this expense can be avoided.

$20,000,000 × (8.5% × 1/12) = $141,667

Aftertax $141,667 × (1 – .40) = $85,000

The total additional interest is:

Extra interest paid	$160,000
Extra interest earned	–85,000
Total additional interest	$ 75,000

These three items amount to a total aftertax investment of:

Call premium	$1,200,000
Flotation costs	751,995
Additional interest	75,000
Total investment	$2,026,995

INTEREST SAVINGS ON NEW ISSUE

Interest on old bond = $20,000,000 × 16% = $3,200,000

Interest on new bond = $20,000,000 × 11% = $2,200,000

Annual savings = $1,000,000

Aftertax savings = $1,000,000 × (1 – .40) = $600,000

PV of annual savings over nine years = $600,000 × 6.6276 = $3,976,560

NPV FOR THE REFUNDING OPERATION

Interest savings	$3,976,560
Investment	–2,026,995
NPV	$1,949,565

Nipigon Lake can save almost $2 million by proceeding with a call on its old bonds. The interest rates used in this example resemble the actual interest rates during the early 1980s. The example illustrates why firms would want to include a call provision when interest rates are very high.

CANADA PLUS CALL In our example, the Nipigon Lake Mining bond had a traditional call feature.[18] Here we illustrate how a Canada plus call would make calling the debt unattractive. Suppose, that when the bonds were issued in 1986, Nipigon debt carried a yield 75 basis points above comparable Canadas. To set up a Canada plus call, Nipigon agrees in 1986 to compensate investors based on a yield of Canada plus 75 basis points if the bonds are ever called.

In our example, by 2001, rates on Canadas have fallen to 10.25 percent and Nipigon could issue new 9-year debt at 11 percent. Given this information, we can now calculate the annual interest penalty Nipigon would have to pay to call the debt:

16% – [Canada + 0.75] = 16% – [10.25 + 0.75] = 5%

In dollars this is 5 percent of $20,000,000 or $1 million. This $1 million is precisely the annual savings from calling the debt with the traditional call calculated earlier. Our example shows that, with the Canada plus call, the debt will not be called.

Should Firms Issue Callable Bonds?

We have seen that the NPV of the call provision at the time a bond is issued is likely to be zero. This means that whether or not the issue is callable is a matter of indifference; we get exactly what we pay for, at least on average.

A company prefers to issue callable bonds only if it places a higher value on the call option than do the bondholders. We consider three reasons a company might use a call provision:

18 Our discussion of the Canada plus call draws on D. J. Fowler, A. Kaplan, and W. A. Mackenzie, "A Note on Call Premiums on U.S. and Canadian Corporate Debt," York University Working Paper, April 1995.

1. Superior interest rate predictions.
2. Taxes.
3. Financial flexibility for future investment opportunities.

SUPERIOR INTEREST RATE FORECASTING The company may prefer the call provision because it assigns a higher probability to a fall in the coupon rate it must pay than the bondholders do. For example, managers may be better informed about a potential improvement in the firm's credit rating. In this way, company insiders may know more about interest rate decreases than the bondholders.

Whether or not the companies truly know more than the creditors about future interest rates is debatable, but the point is they may think they do and thus prefer to issue callable bonds.

TAXES Call provisions may have tax advantages to both bondholders and the company. This is true if the bondholder is taxed at a lower rate than the company.

We have seen that callable bonds have higher rates than non-callable bonds. Because the coupons are a deductible interest expense to the corporation, if the corporate tax rate is higher than that of the individual holder, the corporation gains more in interest savings than the bondholders lose in extra taxes. Effectively, CCRA pays for a part of the call provision in reduced tax revenues.

FUTURE INVESTMENT OPPORTUNITIES As we have seen, bond indentures contain protective covenants that restrict a company's investment opportunities. For example, protective covenants may limit the company's ability to acquire another company or to sell certain assets (for example, a division of the company). If the covenants are sufficiently restrictive, the cost to the shareholders in lost net present value can be large.

If bonds are callable, though, by paying the call premium, the company can buy back the bonds and take advantage of a superior investment opportunity.

CONCEPT QUESTIONS

1. Why might a corporation call in a bond issue? What is this action called?
2. What is the effect on a bond's coupon rate from including a call provision? Why?
3. Why does a Canada plus call effectively make calling debt unattractive?

Appendix Review Problems and Self-Test

B.1 Call Provisions and Bond Values Timberlake Industries has decided to float a perpetual bond issue. The coupon will be 8 percent (the current interest rate). In one year, there is an even chance that interest rates will be 5 percent or 20 percent. What will the market value of the bonds be if they are non-callable? If they are callable at par plus $80.

B.2 Call Provisions and Coupon Rates If the Timberlake bond in Problem C.1 is callable and sells for par, what is the coupon, C? What is the cost of the call provision in this case?

Answers to Appendix Self-Test Problems

B.1 If the bond is not callable, in one year it will be worth either $80/.05 = $1,600 or $80/.2 = $400. The expected price is $1,000. The PV of the $1,000 and the first $80 coupon is $1,080/1.08 = $1,000, so the bond will sell for par.

If the bond is callable, either it will be called at $1,080 (if rates fall to 5 percent) or it will sell for $400. The expected value is ($1,080 + 400)/2 = $740. The PV is ($740 + 80)/1.08 = $759.26.

B.2 In one year, the bond either will be worth $C/.20$ or it will be called for $1,080. If the bond sells for par, then:

$$\$1{,}000 = [C + .5(C/.20) + .5(\$1{,}080)]/1.08$$
$$\$540 = [C + .5(C/.20)]$$
$$= 3.5C$$

The coupon, C, must be $540/3.5 = $154.29.

If the bond had a coupon of $154.29 and was not callable, in one year it would be worth either $154.29/.05 = $3,085.71 or $154.29/.20 = $771.43. There is an even chance of either of these, so we expect a value of $1,928.57. The bond would sell today for ($1,928.57 + 154.29)/1.08 = $1,928.57. The cost of the call provision is thus $928.57. This is quite a bit, but, as we see in a later chapter, this stems from the fact that interest rates are quite volatile in this example.

Appendix Questions and Problems

Basic (Questions B.1–B.8)

B.1 NPV and Refunding Atfan, Inc., has an outstanding callable perpetuity bond with a 9 percent coupon rate. This issue must be called now or never. If it is called, it will be replaced with an issue that has a coupon rate of 6 percent, equal to the current interest rate. The call premium is $180 per bond. Should Atfan refund its outstanding bond issue? What is the NPV of the refunding?

B.2 Interest Rates and Refunding In the previous problem, what would the current rate have to be for Atfan to be indifferent to refunding or not?

B.3 Setting the Coupon Rate Supersoft Corporation has decided to finance its expansion with a perpetual bond issue. The current interest rate is 7 percent. In one year, there is an equal chance that interest rates will either be 6 percent or 8 percent. If this is a callable bond issue and the call premium to be paid is $70 per bond, what does the coupon rate have to be for the bond to sell at par?

B.4 Setting the Call Premium In the previous problem, suppose you want to set the coupon rate on this issue at 7 percent. What would the call premium have to be for the bond to sell at par?

B.5 Pricing Callable Bonds In the previous problem, suppose you set the coupon rate at 7 percent and the call premium at $120. What will the issue sell for?

B.6 Call Provision Costs In the previous problem, what is the cost of the call provision to the firm?

B.7 NPV and Refunding Your company has an outstanding perpetual bond issue with a face value of $50 million and a coupon rate of 8 percent. The bonds are callable at par plus a $150 call premium per bond; in addition, any new bond issues of your firm will incur fixed costs of $9 million. The bonds must be called now or never. What would the current interest rate have to be for you to be indifferent to a refunding operation?

B.8 NPV and Maturity In the previous problem, suppose that bonds in question make annual coupon payments and have 15 years to maturity, rather than being perpetual bonds. If current rates are 7 percent and the bonds must be called now or never, what is the NPV of the refunding operation?

Challenge (Questions B.9 and B.10)

B.9 NPV and Maturity In Problem B.8, what would the current interest rate have to be for you to be indifferent to a refunding operation?

B.10 Refunding and Taxes In Problem B.1, suppose Atfan is in the 40 percent tax bracket. The call premium is a tax-deductible business expense, as is interest paid on the old and new bonds. What is the NPV of the refunding? Note that the appropriate discount rate will be the aftertax borrowing rate. What is the net result of including tax effects on the NPV of refunding operations? Explain.